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IN REPLY REFER TO: Joint Interoperability Test Command (JTE) 30 April 2012

MEMORANDUM FOR DISTRIBUTION

SUBJECT: Special Interoperability Test Certification of the Tellabs 7100 Optical Transport System and 7100 Nano Optical Transport System, Fixed Network Element (F-NE), with Software Release FP 6.2

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 Tellabs 7100 Optical Transport System and 7100 Nano Optical Transport System, both with Software Release FP 6.2, are hereinafter referred to as the System Under Test (SUT). The SUT meets all its critical interoperability requirements and JITC certifies the SUT for joint use in the Defense Information Systems Network (DISN) as a F-NE. The SUT provides additional optical transport interfaces and functional capabilities. JITC evaluated and certifies the SUT for optical transport for the Optical Carrier interfaces detailed in Table 1. Additional sponsor functional capabilities are addressed in Table 2. 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) via a vendor Plan of Action and Milestones to address the concern(s) within 120 days of identification. JITC conducted testing using F-NE requirements within the Unified Capabilities Requirements (UCR) 2008, Change 2, Reference (c), and other sponsor requested requirements. JITC tested the SUT using F-NE test procedures, Reference (d) and test procedures developed to address the sponsor unique requirements. 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 of this memorandum.

3. This finding is based on interoperability testing conducted by JITC, review of the Vendor's Letter of Compliance and Information Assurance (IA) Certification Authority (CA) approval of the IA configuration. JITC conducted Interoperability testing at the Indian Head, Maryland, Test Facility from 6 June through 1 July 2011. The DISA IA CA has reviewed the JITC published IA

Assessment Report for the SUT, Reference (e), and has provided a positive recommendation of the IA configuration on 27 March 2012. The acquiring agency or site will be responsible for the DoD Information Assurance Certification and Accreditation Process (DIACAP) accreditation. The Army originally submitted the SUT as a DISN Optical Transport System under UCR Section 5.5. Based on DISA guidance received 18 January 2012, this product was re-evaluated as a F-NE. Enclosure 2 documents the test results and describes the tested network and system configurations. Enclosure 3, System Functional and Capability Requirements, lists the F-NE Capability Requirements (CR) and Functional Requirements (FR).

4. Section 5.9 of the UCR establishes the interfaces and threshold CRs/FRs used to evaluate the interoperability of the SUT as a F-NE. Tables 1 and 2 list the F-NE, sponsor requested interfaces, CRs, FRs, and the component status of the SUT.

Table 1. SUT Interface Interoperability Status

Interface		Critical (See note 1.)	UCR Ref (UCR 2008, Change 2)	Threshold CR/FR	Status	Remarks
NE	Analog	No	5.9.2.3.1	1,2,4	NA	Not supported by the SUT
	Serial	No	5.9.2.3.2	1,2,4	NA	Not supported by the SUT
	BRI ISDN	No	5.9.2.3.3	1,2,4	NA	Not supported by the SUT
	DS1	No	5.9.2.3.4	1,2,3,4	NA	Not supported by the SUT
	E1	No	5.9.2.3.5	1,2,3,4	NA	Not supported by the SUT
	DS3	No	5.9.2.3.6	1,2,3,4	NA	Not supported by the SUT
	OC-X	No	5.9.2.3.8	1,2,3,4	Certified	SUT met requirements for the following interfaces: OC-48/STM-16; OC-192/STM-64; and, OC-768/STM-256
	IP (Ethernet) 10/100/1000 and 10GE	No	5.9.2.3.9	1,2,4,7	Certified	SUT met requirements for specified interfaces
NM	10Base-X	Yes	5.3.2.4.4	8	Certified	SUT met NM requirements for specified interfaces
	100Base-X	Yes	5.3.2.4.4	8	Certified	
OTHER	10 Gigabit Ethernet-LAN	No	5.9.2.3.9	1,2,4,7	Certified	See notes 2, 3, and 4.
	10 Gigabit Ethernet-WAN	No	5.9.2.3.9	1,2,4,7	Certified	See notes 2, 3, and 4.
	OSC	No	5.9.2.3.9	1,2,3,4,5	Certified	See notes 2, 3, and 4.

NOTES:
1. UCR does not specify any minimum interfaces. The SUT must minimally provide one of the listed ingress and egress interfaces specified.
2. For OTS feature, all client side low speed SONET signals are multiplexed into OC-192 and then that OC-192 signal encapsulated into DWDM at the egress. In addition, client side OC-192 and OC-768 signals are encapsulated into DWDM at egress.
3. For OTS feature, multiple Ethernet GE client side signals are multiplexed into OC-192 and then that OC-192 signal encapsulated into DWDM at the egress. In addition, 10GE signal is mapped into OC-192 and then that OC-192 signal encapsulated into DWDM at Egress.
4. Additional testing provided on Non F-NE requirements.

Table 1. SUT Interface Interoperability Status (continued)

LEGEND:			
100Base-X	100 Mbps Ethernet generic designation	LAN	Local Area Network
10Base-X	10 Mbps Ethernet generic designation	Mbps	Megabits per second
BRI	Basic Rate Interface	NA	Not Applicable
CR	Capability Requirement	NE	Network Element
DS1	Digital Signal Level 1 (1.544 Mbps)	NM	Network Management
DS3	Digital Signal Level 3 (44.736 Mbps)	OC-X	Optical Carrier - X (OC-3, OC-12, etc.,)
DWDM	Dense Wavelength Division Multiplexing	OSC	Optical Supervisory Channel
E1	European Interface Standard (2.048 Mbps)	OTS	Optical Transport System
F-NE	Fixed Network Element	SONET	Synchronous Optical Network
FR	Functional Requirement	STM	Synchronous Transport Module
GE	Gigabit Ethernet	SUT	System Under Test
IP	Internet Protocol	UCR	Unified Capabilities Requirements
ISDN	Integrated Services Digital Network	WAN	Wide Area Network

Table 2. SUT CRs and FRs Status

CR/FR ID	Capability/Function	Applicability (See notes 1 and 2.)	UCR Ref (UCR 2008, Change 2)	Status	Remarks
F-NE CR/FR					
1	**General NE Requirements**				
	General Requirements	Required	5.9.2.1	Met	
	Alarms	Required	5.9.2.1.1	Met	
	Congestion Control & Latency	Required	5.9.2.1.2	Met	
2	**Compression**				
	G.726	Conditional	5.9.2.2	NA	Not supported by the SUT.
	G.728	Conditional	5.9.2.2	NA	Not supported by the SUT.
	G.729	Conditional	5.9.2.2	NA	Not supported by the SUT.
3	**Interface Requirements**				
	Timing	Required	5.9.2.3.7	Met	
4	**Device Management**				
	Management Options	Required	5.9.2.4.1	Met	
	Fault Management	Conditional	5.9.2.4.2	Met	
	Loop-Back Capability	Conditional	5.9.2.4.3	Met	
	Operational Configuration Restoral	Required	5.9.2.4.4	Met	
5	**DLoS**				
	DLoS Transport	Conditional	5.9.2.4.5	NA	Not supported by the SUT.
6	**IPv6 Requirements**				
	Product Requirements	Required	5.3.5.4	Met	SUT is a Layer-2 device and transports IPv4 and IPv6 traffic transparently.
7	**NM Requirements**				
	VVoIP NMS Interface Requirements	Required	5.3.2.4.4	Met	
	General Management Requirements	Required	5.3.2.17.2	Met	

Table 2. SUT CRs and FRs Status (continued)

CR/FR ID	Capability/Function	Applicability (See notes 1 and 2.)	UCR Ref (UCR 2008, Change 2)	Status	Remarks
Other Tested Requirements					
8	**Requirements Applicable to all OTS Elements**				
	Overall Requirements	Conditional	5.5.3.2.2.1	Partially Met	Certified based on sponsor requirements. See note 3.
	Performance Requirements	Conditional	5.5.3.2.2.2	Met	Certified based on sponsor requirements.
	Reliability and Quality Assurance	Conditional	5.5.3.2.2.2.1	Met	Certified based on sponsor requirements.
	Common Physical Design Requirements	Conditional	5.5.3.2.2.3	Partially Met	Certified based on sponsor requirements. See note 4.
	Protection and Restoration	Conditional	5.5.3.2.2.4	Met	Certified based on sponsor requirements.
	Optical Amplifier Requirements				
	Optical Amplifier	Conditional	5.5.3.2.3	Partially Met	Certified based on sponsor requirements. See note 5.
	OLA Physical Design Requirements	Conditional	5.5.3.2.3.1	Met	Certified based on sponsor requirements.
	Muxponder Requirements				
	Muxponder	Conditional	5.5.3.2.4	Partially Met	Certified based on sponsor requirements. See note 6.
	Transponder Requirements				
	Transponder	Conditional	5.5.3.2.5	Partially Met	Certified based on sponsor requirements. See note 7.
	Interface Requirements	Conditional	5.5.3.2.5.1	Partially Met	Certified based on sponsor requirements. See note 8.
	ROADM Requirements				
	ROADM Requirements	Conditional	5.5.3.2.6	Partially Met	Certified based on sponsor requirements. See note 9.
	ROADM Specific Physical Design Requirements	Conditional	5.5.3.2.6.1	Partially Met	Certified based on sponsor requirements. See note 10.
	Requirements Common to Transponder and ROADM				
	Framed Formats	Conditional	5.5.3.2.7.1	Met	Certified based on sponsor requirements.
	Unframed Formats	Conditional	5.5.3.2.7.2	Met	Certified based on sponsor requirements.
	Optical Supervisory Channel Requirements				
	Optical Supervisory Channel	Conditional	5.5.3.2.8	Partially Met	Certified based on sponsor requirements. See note 11.

NOTES:

1. Annotation of 'required' refers to high-level requirement category. Applicability of each sub-requirement is provided in Enclosure 3.
2. The sponsor requested the SUT be assessed against UCR Section 5.5 as an OTS device.
3. The 100G interface and external timing, Line timing, Internal ST3 timing, and Derived DS1 timing mode as per Telcordia Technologies GR-253, Section 5.4 are not supported by the SUT.
4. The SUT equipment complies with ETS 300 019-1-3 Class 3.1E, which has a normal max temperature of 40°C and max humidity of 85%, with exceptional conditions of +45°C and 90% RH. The SUT does not support software upgraded in a modular fashion.
5. The SUT internal OSA does not support 25 GHz ITU grid spacing and reporting of Noise level, Q-Factor, OSNR for each wavelength, and Optical Eye Diagram, also SUT does not support automatic monitoring and reporting on the operation of the Raman pumping lasers including power on, off, optical output power, operating current, and total ORL, but it supports Raman pump failure alarm, and Raman output power and line power can be monitored from 2 external monitor ports.
6. SUT does not support a 4:1 40G MUX, which takes up the same amount of slots as an OC-192 circuit pack.
7. The SUT does not support 100G for unframed wavelength services.
8. The SUT does not support 100Gbps.
9. The SUT does not support colorless wavelength routing. The 7100 and 7100 Nano does not support wavelength hair pinning.
10. The SUT does not comply with UCR 2008, paragraph 5.5.3.2.2.3 because there are nine requirements not met. Table 2-11, in Enclosure 2 provides additional details.
11. The SUT has a maximum span loss of 44 dB. The SUT does not provide an ability to monitor and report BER violations.

LEGEND:

BER	Bit Error Rate	Kbps	Kilobits per second
C	Celsius	LD-CELP	Low Delay-Code Excited Linear Prediction
CR	Capability Requirement	MUX	Multiplexer
dB	Decibel	NA	Not Applicable
DLoS	Direct Line of Sight	NE	Network Element
DS1	Digital Signal Level 1 (1.544 Mbps)	NM	Network Management
ETS	Electromagnetic Telecommunication Standard	NMS	Network Management System
F-NE	Fixed-Network Element	OLA	Optical Line Amplifier
FR	Functional Requirement	ORL	Optical Return Loss
G	Gigabit	OSA	Optical Spectrum Analyzer
Gbps	Gigabit per second	OSNR	Optical Signal-To-Noise Ratio
GHz	Gigaheartz	OTS	Optical Transport System
GR	Generic Requirement	RH	Relative Humidity
ID	Identification	ROADM	Reconfigurable Optical Add Drop Multiplexor
IPv6	Internet Protocol version 6	SUT	System Under Test
ITU	International Telecommunications Union	UCR	Unified Capabilities Requirements
		VVoIP	Voice and Video over Internet Protocol

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 Non-secure 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://jitc.fhu.disa.mil (NIPRNet). Information related to Defense Switched Network (DSN) testing is on the Telecommunications Switched Services Interoperability website at http://jitc.fhu.disa.mil/tssi. All associated data is available on the DISA UCCO website located at https://aplits.disa.mil.

6. JITC testing point of contact is Mr. Son Pham, commercial (301) 743-4258. His e-mail address is Son.Pham@disa.mil, mailing address: 3341 Strauss Avenue, Suite 236, Indian Head, Maryland 20640-5149. The UCCO Tracking Number is 1103201 for the Tellabs 7100 Optical Transport System and 1103301 for the Tellabs 7100 Nano Optical Transport System.

FOR THE COMMANDER:

GRANSTROM.DANIEL.J.1160392475

for

3 Enclosures a/s

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ADDITIONAL REFERENCES

(c) Office of the Assistant Secretary of Defense Document, "Department of Defense Unified Capabilities Requirements 2008, Change 2," December 2010
(d) Joint Interoperability Test Command Document, "Unified Capabilities Interoperability Test Plan," 4 February 2010
(e) Joint Interoperability Test Command, "Information Assurance (IA) Assessment of Tellabs 7100 Optical Transport System and 7100 Nano Optical Transport System, Software Release FP 6.2, (1103201 for the Tellabs 7100 Optical Transport System and 1103301 for the Tellabs 7100 Nano Optical Transport System)," 18 January 2012

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CERTIFICATION TESTING SUMMARY

1. SYSTEM TITLE. Tellabs 7100 Optical Transport System and 7100 Nano Optical Transport System, Fixed Network Element (F-NE), with Software Release FP 6.2.

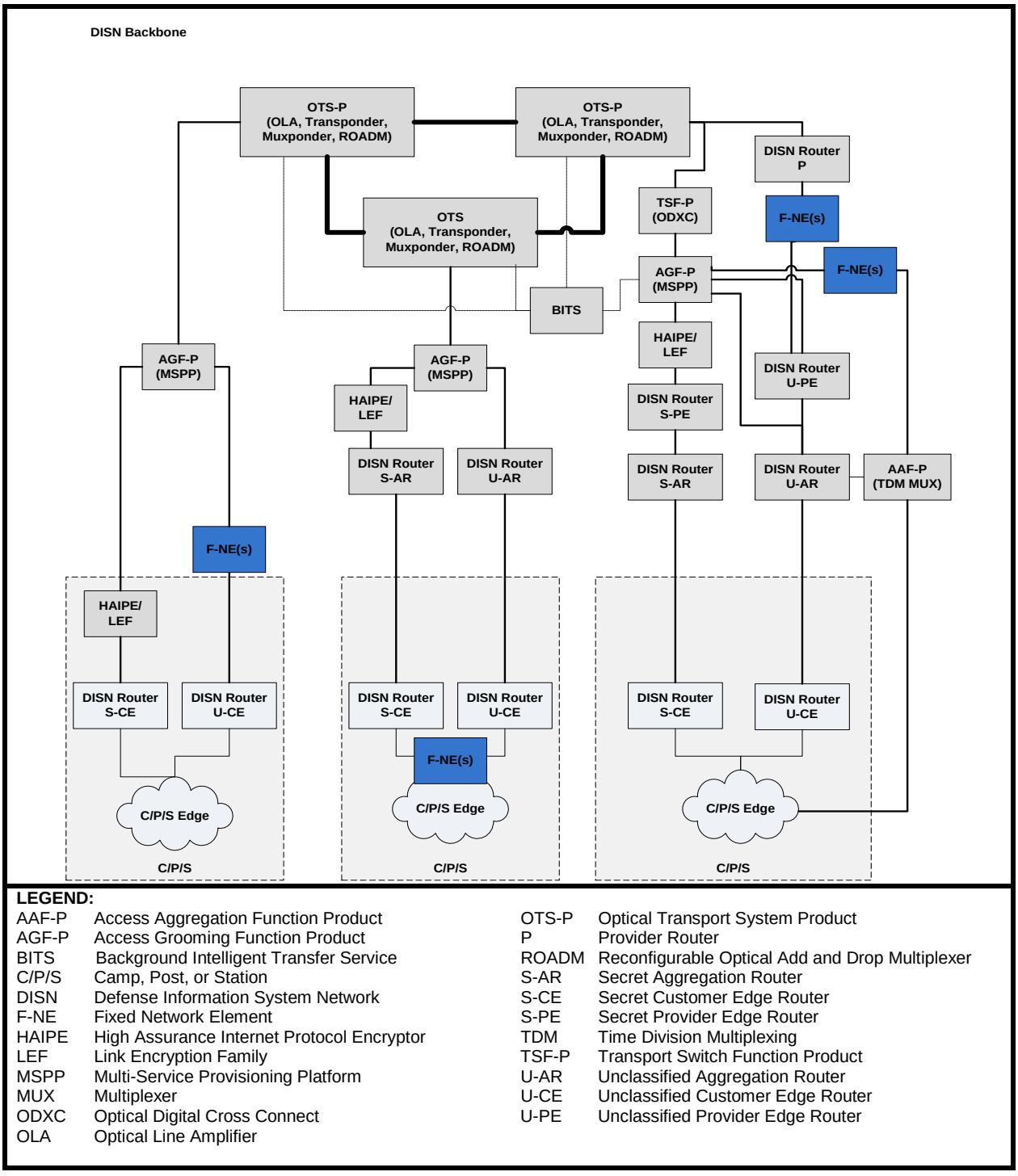
2. SPONSOR. Mr. Jordan Silk, Program Manager, HQUSAISEC, AMSEL-IE-IS, Building 53302, Fort Huachuca, AZ 85613, Email: Jordan.R.Silk.civ@mail.mil.

3. SYSTEM POC. Mark Bremner, Tellabs, 1415 West Diehl Road, Naperville, IL 60563, e-mail: mark.bremner@tellabs.com.

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

5. SYSTEM DESCRIPTION. The Tellabs 7100 Optical Transport System (OTS) and 7100 Nano OTS, both with Software Release FP 6.2, hereinafter referred to as the System Under Test (SUT), are services transport system that combines advanced dynamic optical networking and services layer technologies onto one platform. The Tellabs 7100 uses Dense Wavelength Division Multiplexing to support long haul, metropolitan, regional networks, and campus networks. The Tellabs 7100 OTS, Reconfigurable Optical Add-Drop Multiplex (ROADM) modules provide selectable wavelength add/drop transport capability, hence, offering maximum traffic routing flexibility. The Tellabs 7100 OTS has modular cards available to support Add-Drop Multiplexer (ADM), Layer-2 switch, or Optical Transport Network multiplexing functions. It scales up to 88 wavelengths carrying 40 Gigabits per second (Gbps) of traffic across up to eight ROADM degrees. It provides a wide range of client service rates including 10/100/1000, 100 Fast Ethernet over Fiber Cable, Gigabit Ethernet, 10 Gigabit (G), Optical Carrier (OC)-/12/48/192/768, and Optical Transport Unit (OTU)-1/2/3. The Tellabs 7100 Nano is a compact, power efficient version of the Tellabs 7100 OTS. Like the Tellabs 7100 OTS, the Tellabs 7100 Nano OTS, F-NE provides full 88-channel capacity using up to 40G wavelengths and expands to four ROADM degrees. It can also scale down to a simple OC-192 ADM with a smooth migration path to ROADM technology. The Tellabs 7100 Nano OTS, F-NE offers the same client interface rates, uses the same service cards, and offers the same Synchronous Optical Network (SONET) and Layer-2 switching technology as the Tellabs 7100 OTS. Both SUTs are managed by the Tellabs 7194 Network Management System (NMS), which provides Operation, Administration, Maintenance and Provisioning functionality for a Tellabs dynamic optical network. The Tellabs 7194 is only used for configuration purposes and is not certified under the SUT.

6. OPERATIONAL ARCHITECTURE. JITC tested the SUT under the F-NE Unified Capabilities Requirements (UCR) product category. A high-level Defense Information Systems Network (DISN) node architecture, as depicted in Figure 2-1, displays the F-NE devices. The SUT as F-NE can be deployed to transport DISN services in the Wide Area Network (WAN) and on a camp, post, or station within the Local Area Network (LAN) infrastructure. The SUT solution meets the UCR requirements and can be used to augment WAN or LAN infrastructures.



LEGEND:

AAF-P	Access Aggregation Function Product
AGF-P	Access Grooming Function Product
BITS	Background Intelligent Transfer Service
C/P/S	Camp, Post, or Station
DISN	Defense Information System Network
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
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 F-NE products are established by Sections 5.4 and 5.9 of the Department of Defense (DoD) UCR 2008, Change 2.

7.1 Interfaces. The F-NE products use its interfaces to connect to LAN or DISN WAN infrastructure. The threshold requirements for interfaces specific to the F-NE products are listed in Table 2-1.

Table 2-1. F-NE Interface Requirements

Interface	Critical (See note 1)	UCR Ref (UCR 2008, Change 2)	Threshold CR/FR (See note 2)	Criteria	Remarks
Ingress (LAN side)					
Analog	No	5.9.2.3.1	1, 2, and 4	Meet minimum CR/FRs and interface standards.	Provides access to local infrastructure.
Serial	No	5.9.2.3.2	1, 2, and 4		
BRI ISDN	No	5.9.2.3.3	1, 2, and 4		
DS1	No	5.9.2.3.4	1, 2, 3, and 4		
E1	No	5.9.2.3.5	1, 2, 3, and 4		
DS3	No	5.9.2.3.6	1, 2, 3, and 4		
OC-X	No	5.9.2.3.8	1, 2, 3, and 4		
IP (Ethernet)	No	5.9.2.3.9	1, 2, 4, and 7		
Egress (WAN side)					
Serial	No	5.9.2.3.2	1, 2, 3, and 4	Meet minimum CR/FRs and interface standards.	Provides access to local infrastructure.
DS1	No	5.9.2.3.4	1, 2, 3, and 4		
E1	No	5.9.2.3.6	1, 2, 3, and 4		
DS3	No	5.9.2.3.6	1, 2, 3, and 4		
OC-X	No	5.9.2.3.8	1, 2, 3, and 4		
IP (Ethernet)	No	5.9.2.3.9	1, 2, 4, and 7		
DLoS	No	5.9.2.3.9	1, 2, 3, 4, and 5		
NM					
10Base-X	Yes	5.3.2.4.4	8	Meet minimum CR/FRs and interface standards.	Provides access to local infrastructure.
100Base-X	Yes	5.3.2.4.4	8		

NOTES:
1. UCR does not specify any minimum interfaces.
2. CR/FR requirements are contained in Table 2-2 by CR/FR ID #. CR/FR numbers represent a roll-up of UCR requirements.

LEGEND:

100Base-X	100 Mbps Ethernet generic designation	IP	Internet Protocol
10Base-X	10 Mbps Ethernet generic designation	ISDN	Integrated Services Digital Network
BRI	Basic Rate Interface	LAN	Local Area Network
CR	Capability Requirement	Mbps	Megabits per second
DLoS	Direct Line of Sight	NM	Network Management
DS1	Digital Signal Level 1 (1.544 Mbps)	OC-X	Optical Carrier - X (OC-3, OC-12, etc.,)
DS3	Digital Signal Level 3 (44.736 Mbps)	SUT	System Under Test
E1	European Interface Standard (2.048 Mbps)	UCR	Unified Capabilities Requirements
F-NE	Fixed Network Element	WAN	Wide Area Network
FR	Functional Requirement		

7.2 CR and FR. The F-NE products have required and conditional features and capabilities that are established by Section 5.9 of the UCR. 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)	UCR Ref (UCR 2008, Change 2)	Criteria	Remarks
1	**General NE Requirements**				
	General Requirements	Required	5.9.2.1	Meet applicable UCR requirements. Detailed requirements and associated criteria are provided in Table 3-1 of Enclosure 3.	
	Alarms	Required	5.9.2.1.1		
	Congestion Control & Latency	Required	5.9.2.1.2		
2	**Compression**				
	G.726	Conditional	5.9.2.2	Meet applicable UCR requirements. Detailed requirements and associated criteria are provided in Table 3-1 of Enclosure 3.	
	G.728	Conditional	5.9.2.2		
	G.729	Conditional	5.9.2.2		
3	**Interface Requirements**				
	Timing	Required	5.9.2.3.7	Meet UCR requirements.	Applicable to TDM interfaces
4	**Device Management**				
	Management Options	Required	5.9.2.4.1	Meet applicable UCR requirements. Detailed requirements and associated criteria are provided in Table 3-1 of Enclosure 3.	
	Fault Management	Conditional	5.9.2.4.2		
	Loop-Back Capability	Conditional	5.9.2.4.3		
	Operational Configuration Restoral	Required	5.9.2.4.4		
5	**DLoS**				
	DLoS Transport	Conditional	5.9.2.4.5	Meet UCR DLoS requirements.	
6	**IPv6 Requirements**				
	Product Requirements	Required	5.3.5.4	Meet UCR IPv6 requirements.	
7	**NM Requirements**				
	VVoIP NMS Interface Requirements	Required	5.3.2.4.4	Meet applicable UCR requirements. Detailed requirements and associated criteria are provided in Table 3-1 of Enclosure 3.	
	General Management Requirements	Required	5.3.2.17.2		

Table 2-2. NE CRs and FRs (continued)

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

LEGEND:

ADPCM	Adaptive Differential Pulse Code Modulation	IPv6	Internet Protocol version 6
CR	Capability Requirement	ITU-T	International Telecommunications Union - Telecommunications
CS-ACELP	Conjugate Structure Algebraic Code-Excited Linear Prediction	Kbps	Kilobits per second
DLoS	Direct Line of Sight	LD-CELP	Low Delay Code Excited Linear Prediction
F-NE	Fixed Network Element	NE	Network Element
FR	Functional Requirement	NM	Network Management
G.726	ITU-T speech codec for ADPCM (32 Kbps)	NMS	Network Management System
G.728	ITU-T speech codec for LD-CELP (16 Kbps)	SUT	System Under Test
G.729	ITU-T speech codec for CS-ACELP (8 Kbps)	TDM	Time Division Multiplexing
ID	Identification	UCR	Unified Capabilities Requirements
		VVoIP	Voice and Video over Internet Protocol

7.3 Other. The SUT was originally submitted as an Optical Transport System (OTS) via the Unified Capabilities Certification Office process but based on Defense Information Security Agency (DISA) guidance received 18 January 2012, this product was re-evaluated as a F-NE. The SUT also supports OTS features. JITC tested the SUT's functionalities and capabilities. Tables 2-3 and 2-4 list these requirements on the Other Requirements Section. The OTS products with the designated interfaces can be used to interconnect the DISN WAN infrastructure.

Table 2-3. Other SUT Interface Requirements

Interface	Status	Remarks
10 GbE LAN	Certified	Met commercial interface standards and sponsor information exchanges.
10 GbE-WAN	Certified	
OSC	Certified	

NOTE: The threshold CRs/FRs provides a high-level overview of applicable UCR requirements. For detailed applicability of UCR requirements, refer to Enclosure 3.

LEGEND:

CR	Capability Requirements	OSC	Optical Supervisory Channel
FR	Functional Requirement	SUT	System Under Test
GbE	Gigabit Ethernet	UCR	Unified Capabilities Requirements
LAN	Local Area Network	WAN	Wide Area Network

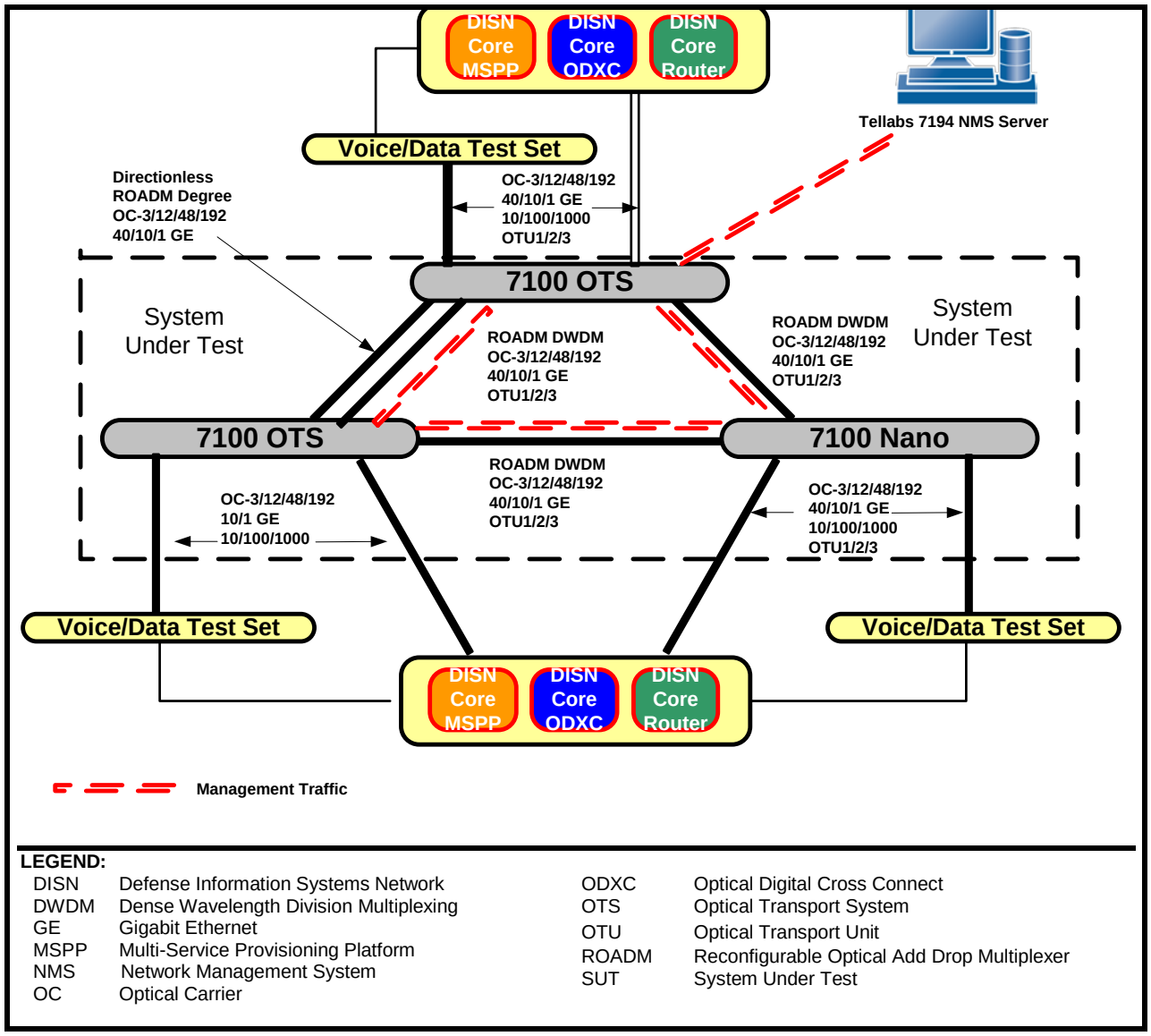
Table 2-4. Other CR/FR Requirements

CR/FR ID	Capability/Function	Applicability	UCR Ref (UCR 2008 Change 2)	Criteria	Remarks
Other Requirements					
8	**Requirements Applicable to all OTS Elements**				
	Overall Requirements	Conditional	5.5.3.2.2.1	Meet Sponsor requirements	
	Performance Requirements	Conditional	5.5.3.2.2.2	Meet Sponsor requirements	
	Reliability and Quality Assurance	Conditional	5.5.3.2.2.2.1	Meet Sponsor requirements	
	Common Physical Design Requirements	Conditional	5.5.3.2.2.3	Meet Sponsor requirements	
	Protection and Restoration	Conditional	5.5.3.2.2.4	Meet Sponsor requirements	
	Optical Amplifier Requirements				
	Optical Amplifier	Conditional	5.5.3.2.3	Meet Sponsor requirements	
	OLA Physical Design Requirements	Conditional	5.5.3.2.3.1	Meet Sponsor requirements	
	Muxponder Requirements				
	Muxponder	Conditional	5.5.3.2.4	Meet Sponsor requirements	
	Transponder Requirements				
	Transponder	Conditional	5.5.3.2.5	Meet Sponsor requirements	
	Interface Requirements	Conditional	5.5.3.2.5.1	Meet Sponsor requirements	
	ROADM Requirements				
	ROADM Requirements	Conditional	5.5.3.2.6	Meet Sponsor requirements	
	ROADM Specific Physical Design Requirements	Conditional	5.5.3.2.6.1	Meet Sponsor requirements	
	Requirements Common to Transponder and ROADM				
	Framed Formats	Conditional	5.5.3.2.7.1	Meet Sponsor requirements	
	Unframed Formats	Conditional	5.5.3.2.7.2	Meet Sponsor requirements	
	Optical Supervisory Channel Requirements				
	Optical Supervisory Channel	Conditional	5.5.3.2.8	Meet Sponsor requirements	

LEGEND:

CR	Capability Requirement	OTS	Optical Transport System
FR	Functional Requirement	ROADM	Reconfigurable Optical Add Drop Multiplexor
ID	Identification	UCR	Unified Capabilities Requirements
OLA	Optical Line Amplifier		

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



LEGEND:

DISN	Defense Information Systems Network	ODXC	Optical Digital Cross Connect
DWDM	Dense Wavelength Division Multiplexing	OTS	Optical Transport System
GE	Gigabit Ethernet	OTU	Optical Transport Unit
MSPP	Multi-Service Provisioning Platform	ROADM	Reconfigurable Optical Add Drop Multiplexer
NMS	Network Management System	SUT	System Under Test
OC	Optical Carrier		

Figure 2-2. SUT's Test Configuration

9. SYSTEM CONFIGURATION. Table 2-5 lists the Tested SUT equipment shown in Figure 2-2, Table 2-6 lists the Non-SUT equipment used to test the SUT, and Table 2-7 lists the test equipment used to generate voice, Synchronous Optical Network, and Internet Protocol (IP) traffic.

Table 2-5. Hardware/Software Tested SUT Equipment

Platform	Software Release	UC Product Type
Tellabs 7100 Optical Transport System	6.2	F-NE
Tellabs 7100 Nano Optical Transport System	6.2	F-NE
Tellabs 7194 Network Management System (NMS)	9.1	NMS
Tellabs 7100 Optical Transport System Hardware-Equipments List		
Item/Card Name	**Part Number**	**Number of Items**
Breaker Frame Alarm Panel - 60 Amp	82.71020C	2
Main Shelf - 60amp w/ Integrated Fan Tray	82.07100A-60	2
Port Shelf w/ Integrated Fan Tray and 3 Fan Modules	82.07100B-60	1
7100 High Capacity Switch Shelf (NEBS)	83.07100B-60-R5	1
System Processor Module without OSC Optics (4GB RAM)	82.71114B-R5	6
HCSS System Processor Module	82.71115-R5	2
88 Channel IR Input Amplifier	81.71188-IR-R5	4
88 Channel Output Amplifier	81.71123C-R5	6
88 Channel 8-Degree RCMM	81.71887B-R5	4
Optical Mux/Demux - Channels 1 to 44	81.714144-R5	4
DX (Directionless) RCMM MODULE - 88CH	81.71T-DXRCMM-R5	2
Universal Packet Fabric 700G	81.71150H-R5	3
SONET/Packet Fabric Module - 280G SONET, 280G Packet	82.71150A-R5	2
SONET/SDH Switching Module - 12 SFPs/1 XFPs/1 MSA	82.71623S-M-R5	4
High Density 10G Transponder	81.71424-NX-R5	2
40G Transponder Multiplexer Module DQPSK	83.71423M-R5	1
8-port OTN Multiplexer	81.71328O-U-r5	2
20G ESM20, 16xSFP, 2xXFP	81.71M-ESM20-R5	2
SFP: OC48 Multirate, SR, 1310 SM (Assume 2 SFP per SMTM-x module)	81.SOC48SR1131S	22
XFP: Tuneable	81.71T-XDWDM-R6	6
XFP: 11.1G, SR, 1310 SM	81.X111GSR1131S	12
SFP: GBE, Electrical, RJ-45 (Works in SMTM-P, SSM in FP5.0)	81.S1GBER450010	4
LRAM-E/ELRAM-E to DCM	155.0001-0017	1
Tellabs 7100 OTS FP6.2 Initialization RTU (per NE) - 7100	81.71FP0620UI	2
Tellabs 7190 FP9.2 Initialization RTU (per NE) - 7100	81.71EM0920UI	2
Tellabs 7190 FP9.2 Initialization RTU (per server) - Small (<51 NEs)	81.71EM092051SVI	2
SUN Netra 210	N/A	2
Tellabs 7100 Nano Optical Transport System Hardware-Equipments List		
Item/Card Name	**Part Number**	**Number of Items**
7100 Nano Main Shelf Kit -- 23"	81.0717MS-KIT-A	1
7100 Nano Port Shelf Kit --23"	81.0717PS-KIT-A	2
Nano System Processor Module	82.71714-R5	6
Reconfigurable OADM Module - 4D - 88 ch, 6-18 dB gain	81.71228-IR-R5	2
Optical Mux/Demux - Channels 1 to 44	82.714144-R5	2
SONET/SDH Switching Module - 12 SFPs/1 XFPs/1 MSA	82.71623S-M-R5	2
High Density 10G Transponder	81.71424-NX-R5	2
20G ESM20, 16xSFP, 2xXFP	81.71M-ESM20-R5	2
8-port OTN Multiplexer	81.71328O-U-r5	2
40G Transponder Multiplexer Module DQPSK	83.71423M-R5	1
SFP: OC48 Multirate, SR, 1310 SM (Assume 2 SFP per SMTM-x module)	81.SOC48SR1131S	4
XFP: Tuneable	81.71T-XDWDM-R6	1
XFP: 11.1G, SR, 1310 SM	81.X111GSR1131S	8
SFP: GBE, Electrical, RJ-45 (Works in SMTM-P, SSM in FP5.0	81.S1GBER450010	2
Tellabs 7100 OTS FP6.2 Initialization RTU (per NE) - 7100	81.71FP0620NI	1
Tellabs 7190 FP9.2 Initialization RTU (per NE) - 7100	81.71EM0920NI	1

Table 2-5. Hardware/Software Tested SUT Equipment (continued)

LEGEND:

CH	Channel
dB	Decibels
DCM	Data Communication Module
Demux	De-Multiplexor
DQPSK	Differential Quadrature Phase Shift Keying
DX	Duplex
ELRAM-E	Extended Long Reach Amplifier Module-Enhanced
F-NE	Fixed Network Element
FP	Feature Pack
G	Gigabit
GB	Gigabit
GBE	Gigabit Ethernet
HCSS	High Capacity Switch Shelf
IR	Intermediate Reach
LRAM-E	Long Reach Amplifier Module-Enhanced
MSA	Multi-Source Agreement
MUX	Multiplexor
NE	Network Element
OADM	Optical Add Drop Multiplexer
OSC	Optical Supervisory Channel
OTN	Optical Transport Network
OTS	Optical Transport System
RAM	Random Access Memory
RCMM	Reconfigurable Channel Multiplexer Module
RTU	Remote Terminal Unit
SDH	Synchronous Digital Hierarchy
SFP	Small Form Factor
SM	Single Mode
SMTM-P	Subrate Multiplexer Transponder Module- Packet
SONET	Synchronous Optical Network
SR	Short Reach
SSM	SONET/SDH Switching Module
SUT	System Under Test
UC	Unified Capabilities
XFP	X-Form Factor Pluggable

Table 2-6 Non-SUT Equipment

Component	Software Version	Function
Cisco 15454	09.00-008I-17.17	ETH 100T-12-G, OC-3IR-STM-1 SH-1310-8, OC-12IR-STM-4-1310-4, DS-1N-14, G1K-4, OC-192SR/STM-64, OC-48 AS-IR-1310, DS-3N-12E
Sycamore ODXC	7.6.21 Build 0562.26.27.57.14	GPIC2 2 X OC-192/STM-64, GPIC 24 x OC-3-12/STM-1-4IR, GPIC2 8 x OC-48/STM-16, USC - OC-192 LR 2c LIM 1
Juniper T320 Router	9.2.R2.15	4 x FE 100 Base X, 10 x GigE LAN 1000 Base TX, 1x OC-192 SM SR2, 1 x 10GigE LAN, XENPAK
Cisco Catalyst 6500	12.1 (13)	48 E ports, 8 ports GigE, 2 port 10GigE

LEGEND:

DS	Digital Signal
ETH	Ethernet
FE	Fast Ethernet
GigE	Gigabit Ethernet
LAN	Local Area Network
LIM	Line Interface Module
LR	Long Reach
OC	Optical Carrier
ODXC	Optical Digital Cross Connect
R	Revision
SM	Single Mode
SR	Short Reach
STM	Synchronous Transport Module
SUT	System Under Test
TX USC	Fast Ethernet over TwistedWires Universal Services Card
X	Place holder for FX or TX

Table 2-7. Test Equipment

Manufacturer	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	
		1000 Base X	
Agilent	Rack Mounted Router Tester 900	10 Gig LAN/WAN	6.11
		10/100/1000 Base-T	
		1000 Base-X	
		OC-48c POS	
		OC-3/12/POS	
Agilent JDSU	T-Berd 8000	OC-192 POS	6.11
		DSU	6.4
		10/100/1000	
		OC-3-12	
		DS-3	
		OC-192	

LEGEND:

DS	Digital Signal	nm	nanometer
DSU	Data Services Unit	OC	Optical Carrier
Gig	Gigabit	POS	Packet Over Synchronous Optical Network
JDSU	Vendor Name	WAN	Wide Area Network
LAN	Local Area Network	X	Place holder for FX or TX

10. TEST LIMITATIONS. None

11. INTEROPERABILITY EVALUATION RESULTS. The SUT meets the critical interoperability requirements for F-NE 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 interface status is provided in Table 2-8.

Table 2-8. SUT F-NE Interface Requirements Status

	Interface	Critical (See note)	UCR Ref (UCR 2008 CH 2)	Threshold CR/FR	Status	Remarks
NE	Analog	No	5.9.2.3.1	1, 2, and 4	NA	Not supported by the SUT
	Serial	No	5.9.2.3.2	1, 2, and 4	NA	Not supported by the SUT
	BRI ISDN	No	5.9.2.3.3	1, 2, and 4	NA	Not supported by the SUT
	DS1	No	5.9.2.3.4	1, 2, 3, and 4	NA	Not supported by the SUT
	E1	No	5.9.2.3.5	1, 2, 3, and 4	NA	Not supported by the SUT
	DS3	No	5.9.2.3.6	1, 2, 3, and 4	NA	Not supported by the SUT

Table 2-8. SUT F-NE Interface Requirements Status (continued)

NE (cont)	OC-X	No	5.9.2.3.8	1, 2, 3, and 4	Certified	SUT met requirements for the following specified interfaces: OC-48/STM-16; OC-192/STM-64; and, OC-768/STM-256
	IP (Ethernet) 10/100/1000 and 10GE	No	5.9.2.3.9	1, 2, 4, and 7	Certified	SUT met requirements for specified interfaces
NM	10Base-X	Yes	5.3.2.4.4	8	Certified	SUT met NM requirements for specified interfaces
	100Base-X	Yes	5.3.2.4.4	8	Certified	

NOTE: UCR does not specify any minimum interfaces.

LEGEND:

100Base-X	100 Mbps Ethernet generic designation	ISDN	Integrated Services Digital Network
10Base-X	10 Mbps Ethernet generic designation	Mbps	Megabits per second
BRI	Basic Rate Interface	NA	Not Applicable
CR	Capability Requirement	NE	Network Element
DS1	Digital Signal Level 1 (1.544 Mbps)	NM	Network Management
DS3	Digital Signal Level 3 (44.736 Mbps)	OC-X	Optical Carrier - X (OC-3, OC-12, etc.,)
E1	European Interface Standard (2.048 Mbps)	STM	Synchronous Transfer Mode
F-NE	Fixed Network Element	SUT	System Under Test
FR	Functional Requirement	UCR	Unified Capabilities Requirements
GE	Gigabit Ethernet	WAN	Wide Area Network
IP	Internet Protocol		

11.2 CR and FR. The SUT's CR/FR statuses are listed in Table 2-9. The detailed CR/FR requirements are provided in Table 3-1 of the System FRs and CRs (Enclosure 3).

Table 2-9. SUT CRs and FRs Status

CR/FR ID	Capability/ Function	Applicability (See note)	UCR Ref (UCR 2008, Change 2)	Status	Remarks
F-NE CR/FR					
1	**General NE Requirements**				
	General Requirements	Required	5.9.2.1	Met	
	Alarms	Required	5.9.2.1.1	Met	
	Congestion Control & Latency	Required	5.9.2.1.2	Met	
2	**Compression**				
	G.726	Conditional	5.9.2.2	NA	Not supported by the SUT
	G.728	Conditional	5.9.2.2	NA	Not supported by the SUT
	G.729	Conditional	5.9.2.2	NA	Not supported by the SUT
3	**Interface Requirements**				
	Timing	Required	5.9.2.3.7	Met	
4	**Device Management**				
	Management Options	Required	5.9.2.4.1	Met	
	Fault Management	Conditional	5.9.2.4.2	Met	
	Loop-Back Capability	Conditional	5.9.2.4.3	Met	
	Operational Configuration Restoral	Required	5.9.2.4.4	Met	
5	**DLoS**				
	DLoS Transport	Conditional	5.9.2.4.5	NA	Not supported by the SUT

Table 2-9. SUT CRs and FRs Status (continued)

CR/FR ID	Capability/ Function	Applicability (See note)	UCR Ref (UCR 2008, Change 2)	Status	Remarks
F-NE CR/FR					
6	**IPv6 Requirements**				
	Product Requirements	Required	5.3.5.4	Met	SUT is a Layer-2 device and transports IPv4 and IPv6 traffic transparently
7	**NM Requirements**				
	VVoIP NMS Interface Requirements	Required	5.3.2.4.4	Met	
	General Management Requirements	Required	5.3.2.17.2	Met	

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

LEGEND:

ADPCM	Adaptive Differential Pulse Code Modulation	IPv6	Internet Protocol version 6
CS-ACELP	Conjugate Structure Algebraic Code-Excited Linear Prediction	ITU-T	ITU Telecommunications Union - Telecommunications Sector
CR	Capability Requirements	Kbps	Kilobits per second
DLoS	Direct Line of Sight	LD-CELP	Low Delay Code Excited Linear Prediction
F-NE	Fixed-Network Element	NA	Not Applicable
FR	Functional Requirement	NE	Network Element
G.726	ITU-T speech codec for ADPCM (32 Kbps)	NM	Network Management
G.728	ITU-T speech codec for LD-CELP (16 Kbps)	NMS	Network Management System
G.729	ITU-T speech codec for CS-ACELP (8 Kbps)	SUT	System Under Test
ID	Identification	UCR	Unified Capabilities Requirements
IPv4	Internet Protocol version 4	VVoIP	Voice and Video over Internet Protocol

a. General NE Requirements

(1) General Requirements. In accordance with (IAW) UCR 2008, Change 2, Section 5.9.2.1 all NEs shall meet the following general requirements and conditions:

(a) The introduction of an NE(s) shall not cause the End-to-End (E2E) average Mean Opinion Score (MOS) to fall below 4.0 as measured over any 5-minute time interval. The SUT met the MOS requirement as measured using test equipment and simulated voice information exchanges.

(b) The introduction of an NE(s) shall not degrade the E2E measured Bit Error Rate (BER) to no more than .03 percent from the baseline minimum E2E digital BER requirement, which is not more than one error in $1x10^9$ bits (averaged over a 9-hour period). The SUT met the requirement as measured using test equipment and simulated information exchanges.

(c) The introduction of an NE(s) shall not degrade secure transmission for secure end devices as defined by UCR 2008, Change 2, Section 5.2.12.6, and DoD Secure Communications Devices. JITC tested secure information

exchanges by using DoD Secure Communications Devices such as Secure Telephone Unit/Secure Terminal Equipment devices with no noted issues.

(d) The NE(s) shall support a minimum modem transmission speed of 9.6 kbps across the associated NE(s). JITC tested this information exchange by using a modem and simulated information exchange with no noted issues.

(e) The NE(s) shall support a minimum facsimile transmission speed of 9.6 kbps across the associated NE(s). JITC tested this information exchange by using a facsimile and simulated information exchanges with no noted issues.

(f) The NE shall transport all call control signals transparently on an E2E basis. JITC tested this information exchange by using the actual call control signals via a Private Branch Exchange Transmission Link Level 1 calls and simulated information exchanges with no noted issues.

(2) Alarms. The NE shall provide the capability of detecting a Carrier Group Alarm (CGA). NEs that support IP ingress/egress traffic either as inbound or outbound NE traffic and/or transport between NE(s) shall support one or more of the following routing protocols: Link-State and/or Distance-Vector, such that the NE can notify the IP network (e.g., LAN, Metropolitan Area Network) the condition of its link state for transporting ingress IP traffic, namely operational or down. The SUT is a Layer-2 device and it passes all the routing protocols, IP link states transparently between connecting end equipments, and it propagates all CGA with no noted issues. In addition, it provides loss of signal alarm in case of loss of connectivity events for connecting end equipments.

(3) Congestion Control and Latency. IAW UCR 2008, the NE shall ensure that congestion and latency between paired NEs does not affect DSN calls in progress or subsequent calls. Call congestion and latency requirements are as follows:

(a) Time Division Multiplexer/Multiplexing (TDM) Transport. The SUT is a Layer-2 device and SUT provides transparent TDM Transport. Therefore, the following TDM transport requirements are not applicable to the SUT. These requirements are the responsibility of connecting end equipments.

1. A dynamic load control signal (e.g., contact closure) shall be provided to the DSN switch.

2. Congestion is not possible in the NE by nature of its functioning (e.g., a TDM multiplexer or transcoder).

3. A software capability in limiting the provisioning the ingress and egress interfaces making congestion impossible even under the worst congestion scenario. This can be done by limiting the bearer or aggregate provisioning.

4. TDM Transport Latency. The addition of NEs with TDM transports shall not increase the one-way latency per NE pair when measured from end to end over any 5-minute period specified as follows:

a. TDM ingress G.711 (non-secure calls) to non-transcoding G.711 TDM egress shall not increase delay more than 10 ms per NE pair as measured E2E.

b. TDM ingress G.711 (non-secure calls) to transcoding TDM egress with compression codecs shall not increase delay by more than 100 ms per NE pair as measured E2E.

c. TDM ingress G.711 (secure calls) to non-transcoding TDM egress G.711 shall not increase delay by more than 50 ms per NE pair as measured E2E.

d. TDM ingress G.711 (secure calls) to transcoding TDM egress with compression codecs shall not increase delay by more than 250 ms per NE pair as measured E2E.

(b) IP Transport. The NE(s) using IP transport shall implement IP congestion control. Congestion may be controlled by using Differentiated Services, which shall be capable of providing preferential treatment for call congestion over other media types and a capability to limit the provisioning of input, and output interfaces so congestion is impossible under the worst transport congestion scenario. The IP interface parameters subject to ingress/egress requirements shall be met. The SUT is a Layer-2 device and it passes all IP traffic transparently, therefore, none of the above IP transport requirement is applicable to the SUT, instead those are responsibility of connecting end equipments.

(c) Direct Line of Sight (DLoS) Transport. The SUT does not provide DLoS Transport.

b. Compression. The SUT does not support Compression.

c. Interface Requirements. Timing. The NE shall be able to derive timing signal from an internal source, an incoming digital signal, or an external source. This requirement applies to TDM interfaces only; IP interfaces do not need to meet this requirement.

d. Device Management. The SUT shall provide the following device management functions:

(1) Management Options. The NE devices are to be managed by at least one of the following:

(a) A front or back panel and/or external console control capability shall be provided for local management and SUT supports only external console control capability. The SUT provides an external console capability.

(b) Remote monitoring and management by the Advanced DSN Integrated Management Support System (ADIMSS). JITC did not verify management of the SUT by ADIMSS.

(2) Fault Management. The SUT may (conditional) report any failure of self-test diagnostic function on non-active and active channels on a noninterference basis to the assigned Network Management System (NMS). JITC verified this conditional capability via Network Management (NM) testing.

(3) Loop-Back Capability. This requirement applies to TDM interfaces only; the SUT does provide loop-back capabilities via its all interfaces.

(4) Operational Configuration Restoral. Loss of power should not remove configuration settings. The SUT shall restore to the last customer-configured state before the power loss, without intervention when power is restored. JITC verified this capability via NM testing.

e. DLoS. DLoS Transport. The SUT does not provide DLoS Transport.

f. Internet Protocol version 6 (IPv6) Requirements. The SUT must meet UCR 2008, Change 2, Section 5.3.5.4 IPv6 requirements for Network Appliance /Simple Server. The SUT is a Layer-2 device and transports Internet Protocol version 4 and IPv6 traffic transparently so requirements specific relating to layer 3 do not apply.

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

(1) Voice and Video over Internet Protocol (VVoIP) NMS Interface Requirements. The physical interface between the DISA 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: Institute of Electrical and Electronics Engineers (IEEE), Ethernet Standard 802.3, 1993; or IEEE, Fast Ethernet Standard 802.3u, 1995.

(2) General Management Requirements. The SUT must support Simple Network Management Protocol v3 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 2, 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 2, paragraph 5.3.2.4.4. There shall be a local craftsperson interface (Craft Input Device for Operations Administration & Management) for all VVoIP network components.

11.3 Other. JITC has conducted additional tests on the SUT. Table 2-10 shows the Additional Interface Requirements under UCR 2008, Change 2, Section 5.5.3.4, and the results**.** The SUT's CR/FR status under OTS requirements is listed in Table 2-11. The SUT met the minimum standards for the UCR 2008, Change 2, Section 5.5.3.2, with the following exceptions:

A. Requirements Applicable to all OTS Elements/Overall Requirements: Telcordia Technologies GR-253, Section 5.4.
B. Requirements Applicable to all OTS Elements/Common Physical Design Requirements – Sub-Paragraphs: 2.3.2, 2.3.17, 2.3.18, 2.3.19, 2.3.28, 2.3.31, 2.3.32, 2.3.33, 2.3.44.
C. Optical Amplifier Requirements/Optical Amplifier – Sub-Paragraphs: 3.19, 3.23
D. Muxponder Requirements/Muxponder – Sub-Paragraph: 4.4.
E. Transponder Requirements/Transponder – Sub Paragraph: 5.12.
F. Transponder Requirements/Interface Requirements – Sub-Paragraph: 5.1.7.
G. ROADM Requirements/ROADM Requirements – Sub-Paragraphs: 6.3, 6.15.
H. ROADM Requirements/ROADM Specific Physical Design Requirements – Sub-Paragraph: 6.1.1.
I. Optical Supervisory Channel Requirements/Optical Supervisory Channel – Sub-Paragraphs: 8.7, 8.9.

The detailed CR/FR requirements are provided in Table 3-2 of Enclosure 3, the System FRs and CRs.

Table 2-10. Additional Interface Requirements Status

Interface	Status	Remarks
10 GbE LAN	Certified	Met commercial interface standards and sponsor information exchanges.
10 GbE-WAN	Certified	
OSC	Certified	

NOTE: The threshold CRs/FRs provides a high-level overview of applicable UCR requirements. For detailed applicability of UCR requirements, refer to Enclosure 3.

LEGEND:

CR	Capability Requirements	OSC	Optical Supervisory Channel
FR	Functional Requirement	UCR	Unified Capabilities Requirements
GbE	Gigabit Ethernet	WAN	Wide Area Network
LAN	Local Area Network		

Table 2-11. Other CRs and FRs

CR/FR ID	Capability/Function	UCR Ref (UCR 2008 Change 2)	Status	Remarks
8	**Requirements Applicable to all OTS Elements**			
	Overall Requirements	5.5.3.2.2.1	Partially Met	See note 1.
	Performance Requirements	5.5.3.2.2.2	Met	
	Reliability and Quality Assurance	5.5.3.2.2.2.1	Met	
	Common Physical Design Requirements	5.5.3.2.2.3	Partially Met	See note 2.
	Protection and Restoration	5.5.3.2.2.4	Met	
	Optical Amplifier Requirements			
	Optical Amplifier	5.5.3.2.3	Partially Met	See note 3.
	OLA Physical Design Requirements	5.5.3.2.3.1	Met	
	Muxponder Requirements			
	Muxponder	5.5.3.2.4	Partially Met	See note 4.
	Transponder Requirements			
	Transponder	5.5.3.2.5	Partially Met	See note 5.
	Interface Requirements	5.5.3.2.5.1	Partially Met	See note 6.
	ROADM Requirements			
	ROADM Requirements	5.5.3.2.6	Partially Met	See note 7.
	ROADM Specific Physical Design Requirements	5.5.3.2.6.1	Partially Met	See note 8.
	Requirements Common to Transponder and ROADM			
	Framed Formats	5.5.3.2.7.1	Met	
	Unframed Formats	5.5.3.2.7.2	Met	
	Optical Supervisory Channel Requirements			
	Optical Supervisory Channel	5.5.3.2.8	Partially Met	See note 9.

NOTES:

1. The 100G interface and external timing, Line timing, Internal ST3 timing, and Derived DS1 timing mode as per Telcordia Technologies GR-253, Section 5.4 are not supported by the SUT.
2. The SUT equipment complies with ETS 300 019-1-3 Class 3.1E, which has a normal max temperature of 40°C and max humidity of 85%, with exceptional conditions of +45°C and 90% RH. The SUT does not support software upgraded in a modular fashion.
3. The SUT internal OSA does not support 25 GHz ITU grid spacing and reporting of Noise level, Q-Factor, OSNR for each wavelength, and Optical Eye Diagram, also SUT does not support automatic monitoring and reporting on the operation of the Raman pumping lasers including power on, off, optical output power, operating current, and total ORL, but it supports Raman pump failure alarm, and Raman output power and line power can be monitored from 2 external monitor ports
4. SUT does not support a 4:1 40G MUX, which takes up the same amount of slots as an OC-192 circuit pack.
5. The SUT does not support 100G for unframed wavelength services.
6. The SUT does not support 100Gbps.
7. The SUT does not support colorless wavelength routing. The 7100 and 7100 Nano does not support wavelength hair pinning.
8. The SUT does not comply with UCR 2008, paragraph 5.5.3.2.2.3 because there are nine requirements that were not met.
9. The SUT has a maximum span loss of 44 dB. The SUT does not provide an ability to monitor and report BER violations.

LEGEND:

BER	Bit Error Rate	IP	Internet Protocol
C	Celsius	ITU	International Telecommunications Union
CR	Capability Requirements	MUX	Multiplexer
dB	Decibel	OC	Optical Carrier
DS1	Digital Signal Level 1 (1.544 Mbps)	OLA	Optical Line Amplifier
ETS	Electromagnetic Telecommunication Standard	ORL	Optical Return Loss
FR	Functional Requirement	OSA	Optical Spectrum Analyzer
G	Gigabit	OSNR	Optical Signal-To-Noise Ratio
Gbps	Gigabit per second	OTS	Optical Transport System
GHz	Gigaheartz	ROADM	Reconfigurable Optical Add Drop Multiplexer
GR	Generic Requirement	SUT	System Under Test
ID	Identification	UCR	Unified Capabilities Requirements

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 Non-secure 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 DSN testing is on the Telecommunications Switched Services Interoperability website at http://jitc.fhu.disa.mil/tssi.

SYSTEM FUNCTIONAL AND CAPABILITY REQUIREMENTS

The Network Elements (NE) and Fixed Network Elements (F-NE) have required and conditional features and capabilities that are established by the Unified Capabilities Requirements (UCR). The System Under Test (SUT) does not need to meet conditional requirements. If they are provided, they must function according to the specified requirements. The detailed Functional requirements (FR) and Capability Requirements for NEs are listed in Table 3-1.

Table 3-1. NE Capability/Functional Requirements Table

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE
1	The introduction of an NE(s) shall not cause the E2E average MOS to fall below 4.0 as measured over any 5-minute time interval.	5.9.2.1 (1)	R
2	The introduction of an NE(s) shall not degrade the E2E measured BER to no more than .03 percent from the baseline minimum E2E digital BER requirement which is not more than one error in 1x109 bits (averaged over a 9-hour period).	5.9.2.1 (2)	R
3	The introduction of an NE(s) shall not degrade secure transmission for secure end devices as defined by UCR 2008, Section 5.2.2, DoD Secure Communications Devices.	5.9.2.1 (3)	R
4	The NE(s) shall support a minimum modem transmission speed of 9.6 kbps across the associated NE(s).	5.9.2.1 (4)	R
5	The NE(s) shall support a minimum facsimile transmission speed of 9.6 kbps across the associated NE(s).	5.9.2.1 (5)	R
6	The NE shall transport all call control signals transparently on an E2E basis.	5.9.2.1 (6)	R
7	[Conditional] The NEs that support a P2N capability shall meet the following additional requirements when deployed in a P2N architectural configuration:	5.9.2.1 (7)	C
7A	The aggregate egress from all NEs in the P2NP architecture must be identical to the aggregate ingress of all NEs in the same P2N architecture. However, if all or part of the P2N is operating in a P2MP mode that is applying multicast from a centrally designated NE to one or more of the associated peripheral NEs, the aggregate of the additional multicast traffic must be accounted for in the egress sum total.	5.9.2.1 (7A)	R
7B	Excluding latency, the P2N AP shall be measured as though it is a P2P architecture at the P2N AP NE endpoints ingress and egress points. As such, the P2N AP must meet all the other stated requirements of a P2P.	5.9.2.1 (7B)	R
7C	For a given P2N AP, the maximum latency allowed E2E, as measured over any 5-minute period at the P2N AP NE ingress and egress points, shall be 5 ms or less, when added in addition to the expected P2P latency. Hence, as an example, if the expected P2P latency requirement for a P2N AP is 50 ms, then P2N AP maximum latency, regardless of the number of NE hops between the ingress and egress NEs, the measured value shall not exceed 55 ms.	5.9.2.1 (7C)	R

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

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE
8	The NE shall be able to propagate Carrier Group Alarms (CGAs) upon physical loss of the TDM interface. The NE shall provide the capability of detecting a carrier group alarm (CGA). When this alarm is detected, all associated outgoing trunks shall be made busy automatically to subsequent customer call attempts. Call attempts on associated incoming trunks shall not be processed. When possible, the Reverse Make Busy feature shall be exercised on incoming trunks. Voice switching systems using a TDM connection to an NE shall receive the proper CGAs from the NE upon loss of the transport link between NEs, regardless of whether the transport link is TDM, IP, or DLoS between the NEs. The NEs that support IP ingress or egress traffic either as inbound or outbound NE traffic and/or transport between NE(s) shall support one or more of the following routing protocols: Link-State and/or Distance-Vector, so the NE can notify the IP network (e.g., LAN, MAN), using one of these routing protocols, the condition of its link state for transporting ingress IP traffic, namely operational or down.	5.9.2.1.1	R
9	The NE shall assure that congestion between paired NEs does not affect DSN calls in progress or subsequent calls. Call congestion handling shall be met in one or more of the following ways.	5.9.2.1.2	R
9A	The NE shall implement TDM congestion control via one of the following methods: A. A dynamic load control signal (e.g., contact closure) shall be provided to the DSN switch per the following requirements: (1) The NE shall provide the capability to handle Carrier Group Alarm (CGA) indications from the carrier systems/equipment using the E-telemetry interface (scan points) for the TDM interfaces provided (e.g., DS0, DS1, and/or OC-X), and, comply to the Telcordia Technologies GR-303-CORE, System Generic Requirements, Objectives, and Interface, December 2000, Issue 4 and Telcordia Technologies TR-NWT-000057 that specifies the use of an COT generated DC contact closure alarm to indicate an “all-accessible-channels busy” condition.	5.9.2.1.2.1 (1A1)	C
9B	(2) The NE when interfaced to the network that provides an E-telemetry interface type (scan points) for alarm management shall be capable of CGA management that is used to minimize the effects of carrier failures on switching systems and on service. CGA scan point (binary condition, i.e., “closed” contact for active and “opened” for inactive states) when “closed” should busy out the failed circuits, release customers from the failed circuits, and prevent the failed circuits from seizing the DSN trunk equipment and prevent the NE from seizing the failed circuits.	5.9.2.1.2.1 (1A2)	C
9C	(3) The DSN CGA System Operation can be divided into three parts, i.e., detection of the carrier failure, conditioning the failed trunk, and reaction of the switching equipment to the processing of the failure. Requirements for scan point CGA are: (a) Sense Point Interface: The switching system shall provide sense points to which external CGAs can be interfaced to, so that failure of the carrier equipment shall cause the trunks to be removed from service. (b) Call Processing Actions: Receipt of a CGA shall cause call processing to be aborted on associated trunks that are not in the talking state. (c) Trunk Conditioning: Receipt of a CGA shall cause the following actions on the affected trunks: (i) Idle trunks shall be removed from the idle list. Subsequent calls for service must be ignored for the duration of the CGA. Busy-back shall be returned on those incoming trunks, which are optioned for busy-back while in the out-of-service state and proper MLPP treatment shall be applied. (ii) Trunks in the talking state shall be monitored for disconnect, after which they are to be placed in the same state as described above for idle trunks.	5.9.2.1.2.1 (1A3)	C
9D	(4) Restoration of Service: All trunks affected shall be returned to their previous state after the CGA is removed. B. Congestion is not possible in the NE by nature of its functioning (e.g., a TDM multiplexer or transcoder). C. A software capability in limiting the provisioning of the ingress and egress interfaces making congestion impossible even under the worst congestion scenario. This can be done by limiting the bearer or aggregate provisioning.	5.9.2.1.2.1 (1A4, 1B, 1C)	C

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

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE
10	2. The addition of NEs with TDM transports shall not increase the one-way latency per NE pair when measured from end to end over any 5-minute period specified as follows: a. Time Division Multiplexing ingress G.711 (non-secure calls) to non-transcoding G.711 TDM egress shall not increase delay more than 10 ms per NE pair as measured end-to-end. b. Time Division Multiplexing ingress G.711 (non-secure calls) to transcoding TDM egress with compression codecs (Section 5.9.2.2, Compression) shall not increase delay by more than 100 ms per NE pair as measured end-to-end. c. Time Division Multiplexing ingress G.711 (secure calls) to non-transcoding TDM egress G.711 shall not increase delay by more than 50 ms per NE pair as measured end-to-end. d. Time Division Multiplexing ingress G.711 (secure calls) to transcoding TDM egress with compression codecs (Section 5.9.2.2, Compression) shall not increase delay by more than 250 ms per NE pair as measured end-to-end.	5.9.2.1.2.1 (2A, 2B, 2C, 2D)	C
11	The NE(s) using IP transport shall implement IP congestion control. Congestion may be controlled by using DiffServ, which shall be capable of providing preferential treatment for call congestion over other media types IAW Section 5.3.3, Network Infrastructure End-to-End Performance Requirements, and a capability to limit the provisioning of input and output interfaces so congestion is impossible under the worst transport congestion scenario. The IP interface parameters subject to ingress or egress requirements shall be met IAW Section 5.9.2.3.9, IP Interface.	5.9.2.1.2.2	C
12	The NE shall implement DLoS congestion control based on the DSN traffic and signaling type to be transported. (Please see Following)	5.9.2.1.2.3	C
13	The NE transporting only TDM bearer and signaling traffic shall implement DLoS congestion control via one or more of the following methods: a. A dynamic load control signal (e.g., contact closure). b. Congestion is not possible in the NE so the maximum ingress throughput into the NE is configured so it does not exceed the DLoS link maximum egress transport capability to include all DLoS overhead control traffic between the transport devices. c. A software capability in limiting the provisioning of the ingress and egress interfaces making congestion impossible even under the worst congestion scenario. This can be done by limiting the bearer or aggregate provisioning.	5.9.2.1.2.3 (1A, 1B, 1C)	C
14	The NE transporting only ingress IP traffic, and using a DLoS transport, excluding 802.11, and/or 802.16 series standards, -shall implement DLoS IP congestion control per Section 5.9.2.1.2.2, For IP Transport. Additionally, IP congestion control may include a standards-based or proprietary protocol between the NEs that will adjust the QoS of the NE based on DLoS transport monitoring feedback to the NE to accommodate for changing environmental link conditions.	5.9.2.1.2.3 (2)	C
15	The NE transporting both TDM and IP ingress traffic simultaneously over the same DLoS transport link shall meet the following requirements: a. [Required] The NE shall provide congestion control so it provides the same level of capability, respectively, for the appropriate traffic type, TDM and IP, per the requirements for single traffic type ingress or egress to the NE. Additionally, the congestion control may include a standards-based or proprietary protocol between the NEs that will adjust the QoS of the NE based on DLoS transport monitoring feedback to the NE to accommodate for changing environmental link conditions. b. [Conditional] The use of DLoS transport shall not increase the one-way latency or packet delay per the requirements for TDM ingress and TDM or IP egress interfaces per the appropriate Section 5.9.2.1.2.1, For TDM Transport, and Section 5.9.2.3.9, IP Interface, respectively.	5.9.2.1.2.3 (3A, 3B)	C
16	The NE used for voice compression shall support at least one of the following standards: • ITU-T Recommendation G.726 • ITU-T Recommendation G.728 • ITU-T Recommendation G.729	5.9.2.2	C
17	If provided, the NE shall provide for a 2-wire and/or 4-wire analog trunk circuit(s) interface that interfaces using industry standard signaling and facility arrangements per one or more of the following:	5.9.2.3.1	C
18A	1. E&M Trunk Circuits: The NE shall interface with exchange carriers using industry standard E&M signaling. The switching system shall interface with Type I and Type II	5.9.2.3.1 (1)	C

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

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE
	E&M signaling in accordance with paragraph 9 and subparagraphs of GR-506-CORE. The switching system shall interface with Type V E&M signaling as defined in Paragraphs 6.8.5, 6.8.6, 6.8.7.2, 6.8.8.2, and 6.8.8.3 of Telcordia Technologies Document SR-2275. The DSN switch analog trunk interface shall always originate on the M-lead.		
18B	2. Single Frequency Trunk Circuits: The NE will interface with external switching facility (SF) equipment using a 4-wire E&M trunk circuit, either Type I or II. The DSN in-band signaling equipment utilizing SF will place a 2600 Hz tone on the circuit to indicate the idle state (on-hook) and the tone will be removed from the circuit to indicate the busy state (off-hook). Signaling states will be conveyed via E and M leads (Type I or II) to the telephone equipment terminating the circuit on the equipment side of the interface. The SF trunk interface consists of only the voice path conductors (T, R, T1, R1), but at a point between this transmission facility interface and the switching function the SF signal will be translated back to the two-state dc signals.	5.9.2.3.1 (2)	C
18C	3. Dual Frequency Trunk Circuits: The Dual Frequency Signaling Unit (DFSU) equipment used in the DSN operates in much the same way as an SF unit, except that whenever the 2600 Hz tone is removed from the circuit a 2800 Hz tone is applied for a short period (175 ms maximum). The 2800 Hz tone burst will serve as a confirmation tone; the receiving signaling unit will only transition from on-hook to off-hook if the loss of the 2600 Hz tone is followed by the 2800 Hz tone. This prevents false on-hook to off-hook transitions from occurring due to a break in the communications circuit. Like the SF trunk interface, the DF trunk interface will consist of only the voice path conductors (T, R, T1, R1). The NE shall interface an external DFSU using a 4-wire E&M trunk circuit with Type I or II E&M signaling. This connection is on the equipment-side of a DF trunk interface.	5.9.2.3.1 (3)	C
19	The NE used for serial interface connections shall be in accordance with one of the following standards: • ITU-T Recommendation V.35 • TIA-232-F • EIA-449-1 • TIA-530-A	5.9.2.3.2	C
20	The ISDN BRI interface shall meet the requirements and conditions IAW Section 5.3.2.31.2, National ISDN 1/2 Basic Access.	5.9.2.3.3	C
21	If provided, the NE shall meet the following DS1 (T1) interface requirements and conditions of a PCM-24 Digital Trunk Interface. PCM-24 Digital Trunk Interface: An NE shall provide a PCM-24 channel digital interface with a 1.544 Mbps T1 bit stream configured in either the D3/D4 (Superframe) framing format or the D5 Extended Superframe (ESF) framing format. D5 is also referred to as Extended Frame (EF). The same framing format shall be used in both directions of transmission. Voice signals shall be encoded in the 8-bit μ (255 quantized values) pulse code modulation (PCM) encoding law. Supervisory and dial pulse (DP) signals shall utilize the A and B bits of the D3/D4 format or the A, B, C, and D bits of the D5 format for pre-CCS7 configurations. Voice channel address in-band signaling shall be provided on individual channels. The D5 format shall be the preferred and system “goal” digital framing format and shall be provided in accordance with MIL-STD-187-700. 1. Interface Characteristics: The NE shall use the DS1 24 channel standard interface as specified in ANSI T1.102, “Digital Hierarchy – Electrical Interfaces.” Table 5.9.2.3.4-1, PCM-24 Electrical Interface Characteristics, provides the electrical characteristics at the interface. Table 5.9.2.3.4-2 and Table 5.9.2.3.4-3 provide a listing of the framing characteristics. (Please see UCR 2008, Change 2-Pages 1898 thru 1900)	5.9.2.3.4	C
22A	2. Supervisory Channel Associated Signaling: On-hook and off-hook status of each channel is transmitted and derived from the coding of the “A” and “B” signaling bits. Trunk seizure, answer supervision, dial pulse digits (DPs), preemption signals, and all other trunk supervisory information shall be sent and received on a per-channel basis using this scheme. Per-trunk signaling in the DSN switching system shall control the value of the “A” and “B” bits to indicate an on-hook (“A” = 0, “B” = 0) or an off-hook (“A” = 1, “B” = 1) condition. When receiving supervisory status on digital trunks using the PCM-24 format, the DSN switching system shall interpret the combination of the “A” bit = 0 andthe “B” bit = 0 as on-hook, and the combination bit = 1 and “B” bit = 1 as an off-hook indication. When signaling on Voice Frequency (VF) channels using the PCM-24 format, the least significant bit of each channel, every six frames, shall	5.9.2.3.4 (2)	C

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

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE
	carry signaling information. Utilizing the four-state signaling option of the Superframe (D3) format, frame 6 shall contain the "A" channel signaling information and frame 12 shall contain the "B" channel signaling information. The switching system shall also interpret the combination of "A" bit = 1, "B" bit = 0, with bit position 2 in all 24 channels in the Superframe (D3) format equal to "0" as a channel alarm indication and shall also interpret the combination of "A" bit = 1, "B" bit = 0 as a remote make busy. In the ESF format ANSI defines a sixteen-state signaling option that labels the signaling bits "A" (frame 6), "B" (frame 12), "C" (frame 18), and "D" (frame 24). Because DSN does not require the "C" and "D" signaling channels the four-state option shall be used to allow changes in "A" and "B" signaling states to be transmitted twice as often. Utilizing Frames 6 and 18 in the 24-frame Extended Superframe shall contain the "A" channel signaling information; frames 12 and 24 shall contain the "B" channel signaling information.		
22B	3. Clear Channel Capability: The NE shall be capable of transmitting and receiving B8ZS line coding in accordance with MIL-STD-187-700.	5.9.2.3.4 (3)	C
22C	4. Alarm and Restoral Requirements: The NE shall provide the alarm and restoral features on the digital interface unit (DIU) as defined in Table 5.9.2.3.4-4, PCM-24 Alarm and Restoral Requirements. (Please see UCR 2008, Change 2-Page 1901)	5.9.2.3.4 (4)	C
23	If provided, the NE shall meet the following E1 interface requirements and conditions of a PCM-30 Digital Trunk Interface: PCM-30 Digital Trunk Interface: The NE shall provide PCM-30 digital interfaces at a data rate of 2.048 Mbps. The PCM-30 interfaces shall meet the requirements of ITU-T Recommendation G.703 and ITU-T Recommendation G.732. Voice signals in the PCM-30 framing format shall utilize the A-law encoding technique in accordance with ITU-T Recommendation G.772 (REV), "Protected Monitoring Points on Digital Transmission Systems." The pertinent requirements for the PCM-30 interface are summarized in Table 5.9.2.3.5-1, PCM-30 Electrical Interface Characteristics. (Please see UCR 2008, Change 2-Page 1902)	5.9.2.3.5	C
23A	1. Supervisory Channel Associated Signaling: When receiving supervisory status on digital trunks using the PCM-30 format, the DSN switching system shall interpret the combination of the "A" signaling channel bit = 1 and the "B" signaling channel bit = 1 as on-hook, and shall interpret the combination of the "A" signaling channel bit = 0 and the "B" signaling channel bit = 1 as an off-hook indication. The DSN switching system shall also interpret the combination of "A" bit = 1 and "B" bit = 0 as a channel alarm indication and a remote make busy. Bits "C" and "D" are not used in the DSN for signaling or control and therefore shall be set to the values "C" = 0 and "D" =1 in accordance with ITU-T Recommendation G.704.	5.9.2.3.5 (1)	C
23B	2. Alarm and Restoral Requirements: The NE shall provide the alarm and restoral features on the DIU in order to be compatible with PCM-30 facilities and terminal equipment, as shown in Table 5.9.2.3.5-3, PCM-30 Alarm and Restoral Requirements. (Please see UCR 2008, Change 2-Page 1903)	5.9.2.3.5 (2)	C
24	The DS3 interface shall meet the following requirements and conditions. Frame structure shall include M13 framing in accordance with ANSI T1.107-2002.	5.9.2.3.6.1 (1)	R
25	Frame structure may include C-bit parity application in accordance with ANSI T1.107-2002.	5.9.2.3.6.1 (2)	C
26	The line coding shall be bipolar 3 zero substitution (B3ZS) in accordance with ANSI T1.102-1993.	5.9.1.5.3.6.2	R
27	The NE shall be able to derive a timing signal from an internal source, an incoming digital signal, or an external source IAW Section 5.3.2.12.14.1.1, Timing Modes (5.3.2.12.14.1.1 Timing Modes): [Required: Media Gateway (MG)] The MGs shall meet the external timing mode requirements specified in the Telcordia Technologies GR-518-CORE, Paragraph 18.1. Most SMEOs and PBX1s will only support line timing 5.3.2.12.14.1.1.1 External Timing Mode - [Required: MG] The MGs shall support external timing modes as defined in Telcordia Technologies TR-NWT-001244. 5.3.2.12.14.1.1.2 Line Timing Mode - [Required: MG] The MGs shall support line timing modes as defined in Telcordia Technologies TR-NW-001244. 5.3.2.12.14.1.2 Internal Clock Requirements 5.3.2.12.14.1.2.1 General - [Required: MG] The MGs shall provide internal clock	5.9.2.3.7	R

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

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE
	requirements as described in the Telcordia Technologies GR-518-CORE, Paragraph 18.2. 5.3.2.12.14.1.1.2.2 Stratum 4 Clock - [Required: MG] The MGs shall provide a stratum 4 or better internal clock. 5.3.2.12.14.1.2 Synchronization Performance Monitoring Criteria - [Required: MG] The MGs shall meet the synchronization performance monitoring criteria as described in Telcordia Technologies GR-518-CORE, Paragraph 18.3		
28	The OC-X interface shall be IAW Section 5.5.3.2, Optical Transport System Interface, and/or appropriate SONET commercial standards. (NOTE: X stands for the capacity (e.g., 3, 48, 192 and higher)	5.9.2.3.8	C
29	The NE having an IP interface and using DLoS transport comprised of 802.11 and/or 802.16 series standards shall instead meet the requirements for a WAB contained in Section 5.3.1.7.2, Wireless. All other IP configurations shall meet the following:	5.9.2.3.9	C
29A	a. Delay. The addition of NEs with IP transports shall not increase the one-way latency per NE pair when measured from end to end over any 5-minute period specified as follows: (1) Time Division Multiplexing ingress G.711 (non-secure calls) to non-transcoding G.711 IP egress shall not increase delay more than 50 ms per NE pair as measured end-to-end. (2) Time Division Multiplexing ingress G.711 (non-secure calls) to transcoding IP egress with compression codecs (Section 5.9.2.2, Compression) shall not increase delay by more than 100 ms per NE pair as measured end-to-end. (3) Time Division Multiplexing ingress G.711 (secure calls) to non-transcoding G.711 IP egress shall not increase delay by more than 50 ms per NE pair as measured end-to-end. (4) Time Division Multiplexing ingress G.711 (secure calls) to transcoding IP egress with compression codecs (Section 5.9.2.2, Compression) shall not increase delay by more than 250 ms per NE pair as measured end-to-end.	5.9.2.3.9	C
29B	b. Jitter. The addition of an NE shall not cause jitter measured from ingress to egress to increase by more than 5 ms averaged over any 5-minute period.	5.9.2.3.9	C
29C	c. Packet Loss. The addition of an NE shall not cause packet loss measured from ingress to egress to increase by more than 0.05 percent averaged over any 5-minute period.	5.9.2.3.9	C
29D	d. [Required: F-NE, D-NE] For VVoIP systems, if the system decrypts the VVoIP traffic and applies a proprietary encryption approach before transmittal between the two components of the single vendor system, then the system proprietary encryption approach shall be one of the encryption and integrity-approved approaches defined in Section 5.4, Information Assurance Requirements NOTE: For example, if the NE decrypts the AS-SIP with TLS packets between the NEs and re-encrypts it using NE proprietary encryption methods, then the proprietary method must be one of the cryptographic methods defined in Section 5.4, Information Assurance Requirements, (e.g., IPSec with AES-128 bit encryption, HMAC-SHA1 for integrity, and DoD PKI for authentication). All Section 5.4, Information Assurance Requirements, approved encryption and integrity approaches use FIPS PUB 140-2 cryptographic modules (or have been granted a formal waiver by National Institute of Standards and Technology (NIST)). Importantly, proprietary only refers to the lack of interoperability with a different vendor's NE and all cryptographic approaches used in Section 5.4, Information Assurance Requirements, are standards based.	5.9.2.3.9	R
29E	e. [Required: F-NE, D-NE] The VVoIP systems that use proprietary encryption approaches within the system shall restore the VVoIP packets to their original format (e.g., AS-SIP with TLS and SRTP) upon exiting from the system to ensure the VVoIP session can complete successfully.	5.9.2.3.9	R
29F	2. [Conditional] The IP interface shall meet the IP requirements detailed in the DISR and Section 5.3, IP-Based Capabilities and Features, inclusive.	5.9.2.3.9	C
30	The NE devices are to be managed by at least one of the following: A front or back panel and/or external console control capability shall be provided for local management. Remote monitoring and management by the Advanced DSN Integrated Management Support System (ADIMSS) or similar Network Management (NM) systems developed by DoD Components. The following requirements apply:	5.9.2.4.1	R

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

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE
	(1) [Required: Data Interface] The NE shall provide network management (NM) data/monitoring via one or more of the following physical interfaces: ** Ethernet/TCP/IP (IEEE 802.3) ** Serial (RS-232)/Asynchronous ** Serial/Synchronous (X.25 and/or BX.25 variant) All data that is collected shall be accessible through these interfaces. For NM purposes, the NE must provide no less than two separate data channels. They may be physically separate (e.g., two distinct physical interface points) or logically separate (e.g., two user sessions through a single Ethernet interface). The data may be sent in ASCII, binary, or hexadecimal data or ASCII text designed for screen/printer display. The data channels shall be used for and, as such, must be capable of providing: ** Alarm/Log Data ** Performance Data (e.g., traffic data) ** NE access (to perform NE data fill administration and network controls) (2) [Required: Fault Management] The DSN telephone switching systems shall detect fault (alarm) conditions and generate alarm notifications. The alarm messages must be sent to the assigned NM Alarm channel in near-real time. No alarm restriction/filtering is necessary. In addition to the data formats in Section 5.3.2.17, Management of Network Appliances, alarms may be sent as Simple Network Management Protocol (SNMP) traps. If this channel is also used to output switch administrative log information, the alarm messages must be distinguishable from an administrative log message (3) [Required: Configuration Management] Requirements for this feature shall be in accordance with Telcordia Technologies GR-472-CORE, Section 4.		
31	The NE shall report any failure of self-test diagnostic function on non-active and active channels on a noninterference basis to the assigned NMS.	5.9.2.4.2	C
32	The NE shall provide loopback capability on each of the trunk-side interfaces IAW ITU-T Recommendation V.54.	5.9.2.4.3	C
33	Loss of power should not remove configuration settings. Unit should be restored to the last customer-configured state before the power loss, without intervention when power is restored.	5.9.2.4.4	R
34	The NEs using DLoS transport shall support the following: a. A minimum MOS score as defined in Section 5.9.2.1, General Requirements, performance requirement or better as measured in any 5-minute interval using ITU-T Recommendation P.862 testing standard. b. [Required] The minimum acceptable maximum transmission range (MTR) shall be 300 feet based on operating in an open air-minimal obstruction, clear line-of-sight environment with the DLoS transport device operating at or near full power mode. Based on the testing results, the estimated maximum performance range while still maintaining MOS requirements, as required in item a, shall hereby be referred to as the NE DLoS transport MTR. The MTR baseline-testing environment shall be while operating in an open air-minimal obstruction, clear line-of-sight environment with the DLoS transport device operating at or near full power mode. The NE shall be tested at a minimum operating height of 25 feet with a clear unobstructed line of sight between NEs at a minimum range of 150 feet. The NEs may be tested with attenuation inserted to simulate the actual NE DLoS transport capability from which the maximum MOS performance range MTR can be extrapolated. The value determined shall be included in the APL report. Refer to Section 5.9.2.5.3, Submission of DLoS Transport NEs to UCCO for DSN Connection Request, concerning guidelines on submitting the DLoS transport NE engineering analysis package.	5.9.2.4.5	R
35	The DLoS transport NEs shall be engineered properly so that the DLoS transport transmitting or receiving devices achieve the required performance requirements in their specific deployed environment. The user shall submit a network design and engineering performance analysis with supporting calculations to meet minimum MOS performance with the request for DSN connection. Included is the calculation and data required for determining the MDR, as defined in Section 5.9.2.5.1, DLoS Transport NE Maximum Deployment Range. For certification procedures, the UCCO submittal shall also include wireless security compliancy as identified in Section 5.9.2.6, Security.	5.9.2.5.3	C

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

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE
36	All components of the NE shall meet security requirements, for each supported mode, as outlined in DoDI 8510.01 and the applicable STIG(s).	5.9.2.6	R
37	1. If a DoD-approved WIDS exists for the DLoS transport technology used, the NE DLoS transport link(s) shall be monitored in according with the appropriate STIG(s).	5.9.2.7	C

LEGEND:

ADIMSS	Advanced DSN Integrated Management Support System
ANSI	American National Standards Institute
APL	Approved Product List
ASLAN	Assured Services LAN
BER	Bit Error Rate
BRI	Basic rate Interface
C	Conditional
CE	Customer Edge
CGA	Carrier Group Alarm
CH	Change
D-NE	Deployed-Network Element
DAA	Designated Approving Authority
DISR	DoD Information technology Standards and Profile Registry
DoD	Department of Defense
DoDI	DoD Instruction
DSN	Defense Switched Network
DVX	Deployed Voice Exchange
E1	European 1 (2048 bps, 30-channel PCM)
E2E	End to End
F-NE	Fixed-Network Element
FIPS	Federal Information Processing Standard
IAW	In Accordance With
IP	Internet Protocol
ISDN	Integrated Services Data Network
ITU	International Telecommunications Union
ITU-T	ITU Telecommunications Union - Telecommunications Sector
LAN	Local Area Network
MAN	Metropolitan Area Networks
MLPP	Multi-Level Precedence and Preemption
MOS	Mean Opinion Score
Ms	Millisecond
NMS	Network Management System
NSA	National Security Agency
PCM	Pulse Code Modulation
PRI	Primary rate Interface
R	Required
SCIP	Secure Communication Interoperability Protocol
SONET	Synchronous Optical Network
STIG	Security Technical implementation Guide
T1	Trunk 1 (1544 bps, 24-channel PCM)
TDM	Time Division Multiplexing
UCCO	Unified Capabilities Certification Office
UCR	Unified Capabilities Requirements
VVoIP	Voice and Video over Internet Protocol

OPTICAL TRANSPORT SYSTEM (OTS) FUNCTIONAL AND CAPABILITY REQUIREMENTS

The OTS have required and conditional features and capabilities that are established by the Unified Capabilities Requirements (UCR). The System Under Test (SUT) need not provide conditional requirements. If they are provided, they must function according to the specified requirements. The detailed Functional requirements (FR) and Capability Requirements for OTS are listed in Table 3-2. Detailed Information Assurance (IA) requirements are included in Reference (e) and are not listed below.

Table 3-2. OTS Capability/Functional Requirements Table

ID	Requirement	UCR Ref (UCR 2008 CH 2)	R/C
	5.5.3.2.2.1 Overall Requirements		
1	The OTS family of equipment shall be currently available, COTS equipment.	5.5.3.2.2.1 (1)	R
2	The OTS shall support a minimum of 80 ITU-T Recommendation G.694.1 grid wavelengths per line-side optical fiber.	5.5.3.2.2.1 (2)	R
3	The OTS shall support a minimum of 160 ITU-T Recommendation G.694.1 grid wavelengths per line-side optical fiber.	5.5.3.2.2.1 (3)	C
4	The OTS shall support mixed bit rate signals: 10 Gbps, 40 Gbps, and 100 Gbps.	5.5.3.2.2.1 (4)	R
5	The OTS shall use the ITU-T specified OSC for out of-band management communication.	5.5.3.2.2.1 (5)	C
6	The OTS shall support all specified wavelengths for all specified bit rate and signal format.	5.5.3.2.2.1 (6)	R
7	The OTS shall support at least standard single mode fiber (ITU-T Recommendation G.652), non-zero dispersion shifted fibers C (ITU-T Recommendation G.655) such as TrueWave-RS®, TrueWave Classic (TWC, TW+), enhanced large effective area or (E-LEAF) or Large Effective Area (LEAF).	5.5.3.2.2.1 (7)	R
8	The OTS shall support the ability of 80, 10Gbps wavelengths to traverse a minimum of 5 ROADM using fibers specified previously for a minimum reach of 2,000 Km without regeneration (optical-to-electrical-to-optical (OEO) conversion) at a BER less than 1 x 10-15.	5.5.3.2.2.1 (8)	R
9	The OTS shall support the ability of 80, 40G wavelengths to traverse a minimum of 5 ROADM using fibers specified previously for a minimum reach of 1,500 km without regeneration (OEO conversion) at a BER less than 1 x 10-15.	5.5.3.2.2.1 (9)	R
10	The OTS shall support the ability of 80, 100G wavelengths to traverse a minimum of 5 ROADM using fibers specified previously for a minimum reach of 1,200nkm without regeneration (OEO conversion) at a BER less than 1 x 10-15.	5.5.3.2.2.1 (10)	R
11	The OTS shall support span length up to 150 km and span loss up to 50 dB. The reach shall not be limited by OSC performance.	5.5.3.2.2.1 (11)	R
12	The OTS shall allow the remote configuration of wavelengths added or dropped from the system.	5.5.3.2.2.1 (12)	R
13	Client interfaces available on the OTS shall meet the accepted standards or specifications for the interface (e.g., OC-192 Telcordia Technologies GR-253-CORE standards, Synchronous Transport Module (STM)-16 and STM-64 ITU-T Recommendations G.707 standards, and Gigabit Ethernet (GbE) and 10GbE IEEE 802.3 standards).	5.5.3.2.2.1 (13)	R
14	The OTS shall support remote shelf location with up to 6 dB optical power budget between terminal and remote locations.	5.5.3.2.2.1 (14)	R
15	The OTS shall support universal (or single part code) MUX/demultiplexer (DEMUX) circuit-packs at all terminals and ROADM nodes.	5.5.3.2.2.1 (15)	R
16	The OTS shall enable pre- and post-dispersion compensation options, at all nodes (terminals, ROADMs, and OLAs).	5.5.3.2.2.1 (16)	R
17	The OTS T&S requirements are defined in Section 5.5.4.2.3, General DISN NE Requirements, and Section 5.5.4.2.4, Optical Transport System.	5.5.3.2.2.1 (17)	R
	5.5.3.2.2.2 Performance Requirements		

18	Jitter tolerance shall comply with Telcordia Technologies GR-253 Type II and ITU-T G.958.	5.5.3.2.2.2 (1)	R

Table 3-2. OTS Capability/Functional Requirements Table (continued)

ID	Requirement	UCR Ref (UCR 2008 CH 2)	R/C
19	Jitter transfer shall comply with Telcordia Technologies GR-253 and ITU-T G.958.	5.5.3.2.2.2 (2)	R
20	In a single vendor environment, a wavelength shall traverse up to at least 20 transponders before termination of the signals is required at a terminal site. This shall be true for all data rates specified.	5.5.3.2.2.2 (3)	R
21	The OTS shall tolerate a persistent input channel signal timing deviation of at least +/– 20 ppm. This implies that the OTS must (1) operate properly in normal condition (i.e. without alarms) when any one or all of the tributaries have long-term frequency offsets of up to +/– 20 ppm and (2) maintain the system performance objectives for concatenated OTS systems.	5.5.3.2.2.2 (4)	R
22	When a signal passes through concatenated OTS sections, the output jitter shall not exceed the network interface limits of ITU-T G.825.	5.5.3.2.2.2 (5)	R
23	When one or more channels (up to 90 percent) fail or are removed (either instantaneously or sequentially), the remaining channels shall not experience increasing bit errors or loss of operating margin. In addition, when failed channels are restored or new channels are added, the existing channels shall not experience any transient or long-term performance deterioration.	5.5.3.2.2.2 (6)	R
24	Maximum uncompensated PMD the system can tolerate at 40/100 Gbps shall not exceed that tolerated at 10 Gbps.	5.5.3.2.2.2 (7)	R
	5.5.3.2.2.2.1 Reliability and Quality Assurance		
25	The OTS equipment shall meet the following quality program requirements, unless specifically overridden or modified by another requirement in this document: • Telcordia Technologies GR-282-CORE, Software Reliability and Quality Acceptance Criteria • Telcordia Technologies GR-2911-CORE, Software Inventory for Network Element Software Management • Telcordia Technologies TR-NWT-000179, Software Quality Program Generic Requirements • Telcordia Technologies TR-NWT-000418, Generic Reliability Assurance for Fiber Optic Transport Systems • Telcordia Technologies SR-NWT-002419, Software Architecture Review Checklists	5.5.3.2.2.2.1 (1)	R
26	A list shall be available of country of origin of the critical components as well as final assembly location of the system.	5.5.3.2.2.2.1 (2)	R
	5.5.3.2.2.3 Common Physical Design Requirements		
	All equipment to be deployed in the central office environment, regardless of application, must comply with the requirements of this section. Mission criticality or presence of network traffic bring other criteria into play, but this set must always be present to protect the people working inter-facility and the other more critical equipment.		
27	Each OTS element shall meet requirements addressed in this document and shall have met European Community (EC) or Pacific (PAC) Host Nation approvals required for foreign countries. Provide information on the countries that the equipment is currently approved, including equipment part numbers and other applicable documentation.	5.5.3.2.2.3 (1)	R
28	The vendor shall have a program underway to obtain approvals and permits for connection and operation of the equipment to the public networks in the EC and PAC areas. A list of countries where such approval has been obtained or is actively being worked toward approval is also required. (Note that this list will change with time.).	5.5.3.2.2.3 (2)	R
29	Each network element shall meet requirements addressed in this section and shall be compliant, at a minimum, without future hardware and/or memory upgrades or replacements.	5.5.3.2.2.3 (3)	R
30	Equipment racks' weight shall be within generally acceptable standards defined for raised floor application.	5.5.3.2.2.3 (4)	R
31	Equipment racks shall allow cable installation above and below each rack.	5.5.3.2.2.3 (5)	R

Table 3-2. OTS Capability/Functional Requirements Table (continued)

ID	Requirement	UCR Ref (UCR 2008 CH 2)	R/C
32	Each OTS element shall be able to receive all types of cables from the top or bottom of the bay/cabinets. When receiving from the bottom, it shall be able to accommodate a raised floor environment.	5.5.3.2.2.3 (6)	R
33	All inter-bay cabling shall be routed above and below each rack allowing various different cable lengths up to 100 m. If the equipment cannot support 100 m, the vendor shall state the maximum cable length supported.	5.5.3.2.2.3 (7)	R
34	Within an OTS element, all intra-system cabling shall maximize separation of redundant cables and fibers (i.e., working/protection, east/west, timing cables, switch cables, etc.).	5.5.3.2.2.3 (8)	R
35	All working signal cables shall be routed on separate physical paths from the protection cables within the system. Between systems, all separations shall be maintained. All inter-system connections shall be able to support a minimum distance of 100m.	5.5.3.2.2.3 (9)	R
36	A and B power cables shall have physically diverse routing within the bay/cabinet.	5.5.3.2.2.3 (10)	R
37	Current drain information shall be provided to outline current draws in both normal and worst case voltage scenarios. (The latter information shall also address impacts of failed feeds and temperature where variable speed fans or other factors make such considerations appropriate). When multiple configurations are possible because of card variety, test data on several "generic" configurations shall be provided with a table of power numbers to help the user interpolate the approximate values of other configurations.	5.5.3.2.2.3 (11)	R
38	Each OTS element/shelf/circuit pack, whichever is the smallest independent load device of the OTS element, shall obtain power from two completely independent power units. Furthermore, the return path from the power units shall remain completely independent (Telcordia Technologies TR-NWT-000295). If one of the power units fails, an alarm shall be generated and the load shall be carried by the other unit without manual intervention and without interruption of service or functionality. The other power unit shall support the operation of the element/shelf/circuit pack until the problem with the faulty unit is corrected.	5.5.3.2.2.3 (12)	R
39	All OTS elements shall conform to the spatial and environmental criteria specified in Telcordia Technologies FR 796 and Telcordia Technologies GR-63-CORE.	5.5.3.2.2.3 (13)	R
40	All OTS elements, along with its power distribution panel and all associated/ancillary hardware, shall be capable of being mounted in standard EIA 310C 23" inches relay rack, 84" in height.	5.5.3.2.2.3 (14)	R
41	All OTS elements shall be capable of being operated and maintained with access only to the front of the unit.	5.5.3.2.2.3 (15)	R
42	All OTS elements shall be capable of being mounted in a back-to-back arrangement or directly against a building wall	5.5.3.2.2.3 (16)	R
43	All OTS elements, along with its power distribution panel and all associated/ancillary hardware, shall be capable of being mounted in standard EIA 310C 23" relay rack, 78" in height.	5.5.3.2.2.3 (17)	R
44	All OTS elements, along with its power distribution panel and all associated/ancillary hardware, shall be capable of being mounted in standard EIA 19" relay rack, 78" in height.	5.5.3.2.2.3 (18)	R
45	All OTS elements, along with its power distribution panel and all associated/ancillary hardware, shall be capable of being mounted in X-Mark/CDT Cabinets, part number XSL78-4-1S0002, size 78" × 23" × 30".	5.5.3.2.2.3 (19)	R
46	All OTS elements shall demonstrate an operational availability of all functions and services of 99.9997 percent.	5.5.3.2.2.3 (20)	R
47	All OTS elements shall comply with the earthquake, office vibration, and transportation vibration criteria specified in Telcordia Technologies GR-63, section 4.4.	5.5.3.2.2.3 (21)	R
48	All OTS elements shall be fully Network Equipment Building System (NEBS), Level 3 compliant.	5.5.3.2.2.3 (22)	R
49	All OTS elements shall meet the environmental conditions described in Telcordia Technologies GR-63-CORE.	5.5.3.2.2.3 (23)	R
50	All OTS elements shall meet the environmental conditions described in ETSI ETS-300-019.	5.5.3.2.2.3 (24)	R

Table 3-2. OTS Capability/Functional Requirements Table (continued)

ID	Requirement	UCR Ref (UCR 2008 CH 2)	R/C
51	All OTS elements shall be designed to operate in a communication equipment environment, adjacent to or in the vicinity of others types of equipment which may include digital radio equipment, fiber optic terminal equipment, FDM analog microwave, VHF/UHF base stations, satellite ground terminals, transfer trip and power line carrier equipment, and telephone signaling equipment.	5.5.3.2.2.3 (25)	R
52	All OTS elements shall meet the EMC/EMI requirements defined in: Telcordia Technologies GR-1089-CORE Electromagnetic Compatibility (EMC) and Electrical Safety - Generic Criteria for Network Telecommunications Equipment.	5.5.3.2.2.3 (26)	R
53	All OTS elements shall meet the EMC/EMI requirements defined in FCC Part 15 Class A.	5.5.3.2.2.3 (27)	R
54	All OTS elements shall meet the EMC/EMI requirements defined in ETS EN 50082.	5.5.3.2.2.3 (28)	R
55	All OTS elements shall meet the EMC/EMI requirements defined in ETS EN 55022 Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement.	5.5.3.2.2.3 (29)	R
56	All OTS elements shall meet the EMC/EMI requirements defined in ETS EN 300-386 EMC and Radio Spectrum Matters (ERM); Telecommunication OTS element; EMC Requirements.	5.5.3.2.2.3 (30)	R
57	All OTS elements shall be designed to operate continuously in the following environment ranges without degradation. Temperature: 0 to +50°C, Humidity: 5 to 95 percent relative humidity, without condensation.	5.5.3.2.2.3 (31)	R
58	All OTS elements shall be designed to be operational after transportation and/or storage in the following environment ranges: Temperature: –40 to +70°C, Humidity: 5 to 95 percent relative humidity, without condensation.	5.5.3.2.2.3 (32)	R
59	All OTS elements shall be designed to operate continuously in the following environment range without degradation. Altitude: –100 to 15,000 feet AMSL.	5.5.3.2.2.3 (33)	R
60	All OTS elements shall be designed to be operational after transportation and/or storage in the following environment range: Transport Altitude: –100 feet to +40,000 feet AMSL.	5.5.3.2.2.3 (34)	R
61	All OTS elements shall adhere to NEBS level 3 compliance standards for acceptable voltage ranges, EMI, and ESD safety, and shall be operable using standard 48V DC power as well as having redundant isolated power input feeds. For certain sites, an alternative AC/DC rectifier may need to be supplied to power the system and shall be able to switch 110/220 V with redundant isolated power modules.	5.5.3.2.2.3 (35)	R
62	All OTS elements shall be operational throughout the battery voltage range of: –41.5 to –56 VDC.	5.5.3.2.2.3 (36)	R
63	All OTS elements shall not be damaged and recover to normal performance following application of the following maximum transient voltages for the duration's given (nominal voltage 48 VDC): 75 Vp-p for 1 msec, 60Vp-p for 500 msec.	5.5.3.2.2.3 (37)	R
64	All OTS elements in the transport layer primary OS interface shall provide the capability for reporting alarms of external equipment and general housekeeping alarms. A minimum of 16 user-defined alarms shall be provided, with the option to expand to 32 user-defined alarm points. Capability shall be provided for minimum of eight user-defined remote control points for external functions. This capability shall be provided by relays, not TTL.	5.5.3.2.2.3 (38)	R
65	The OTS shall support having all data cross connects stored locally and redundantly; and automatically restored without user intervention, in the case of failure, within a period of five minutes.	5.5.3.2.2.3 (39)	R
66	The OTS shall provide the capability to roll back to the previous operational version of software.	5.5.3.2.2.3 (40)	R
67	The OTS shall conform to memory administration, and system administration and security standards as documented. Telcordia Technologies GR-472 and GR-253.	5.5.3.2.2.3 (41)	R
68	All future software for the OTS shall interoperate with the previous deployed GIG-BE system operational software version/release.	5.5.3.2.2.3 (42)	R
69	The OTS shall support software upgrades that directly use or translate the previous version's configuration database.	5.5.3.2.2.3 (43)	R
70	The software of the OTS shall be designed and upgraded in a modular fashion so that an entire code does not have to be replaced when a portion is upgraded.	5.5.3.2.2.3 (44)	R

Table 3-2. OTS Capability/Functional Requirements Table (continued)

ID	Requirement	UCR Ref (UCR 2008 CH 2)	R/C
71	The OTS shall be designed with an accessible file system to allow for multiple versions of software, logs, and file manipulation/integrity checks to be performed prior to upgrading or downgrading software and/or firmware.	5.5.3.2.2.3 (45)	R
72	All equipment shall have been tested and register as compliant to the following Electrical Safety standards: UL-1950, EN60950, and IEC 60950.	5.5.3.2.2.3 (46)	R
	5.5.3.2.2.4 Protection and Restoration		
73	OTS shall support 1+1 wavelength protection and restoration	5.5.3.2.2.4 (1)	R
74	The "Active" and "Standby" wavelengths shall be diversely routed.	5.5.3.2.2.4 (2)	R
	5.5.3.2.3 Optical Amplifier		
75	The system shall support the use of an optical connector for connecting optical amplifier (OA) to the OSP fiber; Raman amplifiers may not be directly spliced to the transmission fiber and must be field-replaceable, without the need for special equipment.	5.5.3.2.3 (1)	R
76	The total optical power emitted from the OTS to be coupled into the fiber, shall not exceed the power limit of IEC Class 3B (+27dBm).	5.5.3.2.3 (2)	R
77	The OTS shall monitor and report on the operation of the Raman pumping lasers including power on, off, optical output power, operating current, and total ORL.	5.5.3.2.3 (3)	R
78	Once detecting the failure of Raman pumping lasers, the OTS shall generate an alarm, but shall not shut off the system.	5.5.3.2.3 (4)	R
79	(Reserved)	5.5.3.2.3 (5)	R
80	The OTS shall have an integrated power management algorithm, which invokes power monitoring and adjustment devices to compensate for power variations across the optical wavelengths.	5.5.3.2.3 (6)	R
81	The OLA system shall be able to balance individual wavelengths so that power output levels exhibit less than 0.5 dB variance from the mean output level without remote or direct intervention from a network operator.	5.5.3.2.3 (7)	R
82	When one or more channels fail or are removed, the remaining channels shall not experience increased bit errors or loss of operating margin.	5.5.3.2.3 (8)	R
83	When failed channels are restored or new channels are added, the existing channels shall not experience any transient or long-term performance deterioration.	5.5.3.2.3 (9)	R
84	The power management algorithm shall cause no interruptions in OSC communications at any time.	5.5.3.2.3 (10)	R
85	OSC signals shall experience no increased errors at any time up to EOL, including during wavelength provisioning or line equalization.	5.5.3.2.3 (11)	R
86	Amplifiers shall require less than 1 ms to return all wavelength power output levels to within 1 dB of pre-insertion/drop levels – transient suppression statistics shall be provided for OLA systems.	5.5.3.2.3 (12)	R
87	The OA shall maintain safe (Hazard level 1) system operation in the event of input signal loss or fiber cut.	5.5.3.2.3 (13)	R
88	Chromatic dispersion compensation shall be able to fully compensate a 150 km span for each fiber type, as specified in Section 5.5.3.1, Fiber Plant.	5.5.3.2.3 (14)	R
89	Chromatic dispersion compensation shall be provided for different fiber lengths in 10, 20, or 30 km increments, if the technique requires the compensation to be periodically dispersed.	5.5.3.2.3 (15)	R
90	The OTS shall enable pre- and post- dispersion compensation options.	5.5.3.2.3 (16)	R
91	A secured external monitor port is required at each OA. For devices that contain a full-featured internal Optical Spectrum Analyzer (OSA), an external monitor port shall still be required.	5.5.3.2.3 (17)	R
92	Internal OSA functionality shall support 25 GHz ITU grid spacing with minimum 5 percent wavelength accuracy.	5.5.3.2.3 (18)	C
93	Internal OSA functionality shall provide a minimum accuracy of 0.2 dB for each wavelength.	5.5.3.2.3 (19)	R
94	Internal OSAs shall provide sweep times of less than 1 second.	5.5.3.2.3 (20)	R
95	Internal OSAs shall provide the ability to display all wavelengths simultaneously.	5.5.3.2.3 (21)	R
96	Internal OSAs shall provide the ability to retrieve data to be stored at a remote storage site.	5.5.3.2.3 (22)	R
97	Internal OSAs shall provide the ability to view various calculated data such as gain tilt, output tilt, gain variation, gain difference, noise level, total received power, total launched power, etc.	5.5.3.2.3 (23)	R

Table 3-2. OTS Capability/Functional Requirements Table (continued)

ID	Requirement	UCR Ref (UCR 2008 CH 2)	R/C
98	Internal OSAs shall provide the ability to report Quality (Q) factor (not critical).	5.5.3.2.3 (24)	R
99	Internal OSAs shall have the ability to estimate Optical Signal to Noise Ratio (OSNR) for each wavelength.	5.5.3.2.3 (25)	R
100	All measurements made available at the internal OSA shall be available at the external OSA port (not critical).	5.5.3.2.3 (26)	R
	5.5.3.2.3.1 OLA Physical Design Requirements		
101	The OLA shall support hot swappable modular components, including but not limited to fans, amplifier modules, in-band/out-of-band management interfaces, power supplies, and control processor.	5.5.3.2.3.1 (1)	R
102	The OLA shall support redundant Fans management interfaces power supplies control processors	5.5.3.2.3.1 (2)	R
103	The OA shall be able to fit into either a 19" or a 23" rack with depth no greater than 30" and height no more than 84".	5.5.3.2.3.1 (3)	R
104	The OLA overall dimensions shall be no more than one 7.2-foot standard Telco rack for a full 80 wavelengths bi-directionally, or two racks for 160 wavelengths, including out-of-band management functions.	5.5.3.2.3.1 (4)	R
105	The OLA power consumption shall be kept below 2,000 watts for all equipment at an OLA site.	5.5.3.2.3.1 (5)	R
106	The vendor shall identify their OLA power and space requirements for all specified configurations.	5.5.3.2.3.1 (6)	R
	5.5.3.2.4 Muxponder Requirements		
107	Transponders shall support a four-to-one muxponder (4-10G signals multiplexed into one 40G signal). If the vendor equipment supports this functionality, the equipment shall meet the requirements listed in this section (3.2.1.3).	5.5.3.2.4 (1)	R
108	The OTS shall support a 4:1 40G multiplexer (MUX). The 4:1 40G MUX shall receive four standards compliant OC-192/STM-64 signals, from one to four sources, and multiplex them onto a signal for transport over a 40G wavelength on the system.	5.5.3.2.4 (2)	R
108	The 4:1 40G MUX shall transmit a 40G channel in each of the operating bands specified by the vendor. The vendor shall indicate any excluded band.	5.5.3.2.4 (3)	R
109	The 4:1 40G MUX shall occupy no more physical space than an OC-192/STM-64 transmit/receive pack.	5.5.3.2.4 (4)	R
110	The 4:1 40G MUX shall transfer the OC-192/STM-64 signals through the system transparently.	5.5.3.2.4 (5)	R
111	The engineering rules for the 4:1 40G MUX configuration shall be the same as the standard OC-768/STM-256 configuration without the need to change any system components, including dispersion compensation.	5.5.3.2.4 (6)	R
112	The OC-192/STM-64 interface (i.e. SR, etc.) for a 4:1 40G MUX shall have identical compliance to all of the requirements for an OC-192/STM-64 interface to an OC-192/STM-64 standard transponder as specified in this document.	5.5.3.2.4 (7)	R
113	An OC-48/STM-64 through the OTS that is multiplexed and demultiplexed through the 4:1 10G MUX shall meet the same performance requirements as an OC-192/STM-64 signal through the OTS using OC-192/STM-64 transponders. Performance requirements include, but are not limited to BER, Errored Seconds (ES), Severely Errored Seconds (SES), and Availability.	5.5.3.2.4 (8)	R
114	An OC-192/STM-64 through multiple concatenated systems containing 4:1 10G MUX shall meet the same performance requirements as an OC-192/STM-64 signal through concatenated OTSs using OC-192/STM-64 transponders. The same number of concatenated 4:1 10G MUX shall be supported as the number of concatenated OC-192/STM-64 transponders. Performance requirements include, but are not limited to Jitter Generation and Tolerance.	5.5.3.2.4 (9)	R
115	The maximum number of 40G channels equipped with 4:1 40G MUX in an OTS must be equal to the maximum number of OC-768/STM-256 channels supported in an OTS.	5.5.3.2.4 (10)	R
116	The 4:1 10G MUX shall operate without degradation if less than four of the OC-192/STM-64s have a valid OC-192/STM-64 signal.	5.5.3.2.4 (11)	R

Table 3-2. OTS Capability/Functional Requirements Table (continued)

ID	Requirement	UCR Ref (UCR 2008 CH 2)	R/C
117	The loss of one or more provisioned OC-192/STM-64 inputs to a 4:1 10G MUX shall not affect the performance of any other provisioned OC-192/STM-64 on that multiplexed channel.	5.5.3.2.4 (12)	R
	5.5.3.2.5 Transponder Requirements		
118	Transponders shall comply with the DWDM wavelength grid as specified in ITU-T G.694.1.	5.5.3.2.5 (1)	R
119	Transponders shall support tunable lasers, which are tunable over whole band.	5.5.3.2.5 (2)	R
120	All transponders shall support built-in self BER test function	5.5.3.2.5 (3)	R
121	All transponders shall support local and remote loop-back capability on the line side for built-in self-BER test.	5.5.3.2.5 (4)	R
122	All transponders shall support total end-to-end (E2E) signal propagation delay (at transponder ingress to egress) reporting function.	5.5.3.2.5 (5)	C
123	All transponders shall support user selectable line side FEC (Forward Error Correction), i.e., no FEC, ITU-T G.709 compliant standard FEC, and enhanced FEC SFEC or EFEC modes.	5.5.3.2.5 (6)	R
124	Transponders shall support ITU-T G.709 specifications for OTN services.	5.5.3.2.5 (7)	R
125	Transponders shall support switching of framing protocols (OTN, SONET, 10GBE, etc.) without requiring downloading or switching firmware/software and physical removal of the transponder from the slot.	5.5.3.2.5 (8)	R
126	Transponders shall have non-intrusive SONET/SDH B1 monitoring capability	5.5.3.2.5 (9)	R
127	Transponder shall have integrated EDC (Electronic Dispersion Compensation) for all specified fiber types to support minimum un-regenerated reach of 2000 kms.	5.5.3.2.5 (10)	C
128	The vendor shall supply through-transponder(s) to eliminate unnecessary O/E conversions for wavelength regeneration at ROADM, OXC, and regenerator sites.	5.5.3.2.5 (11)	R
129	The vendor shall provide a transponder to interface with 10/40/100Gbps unframed wavelength services.	5.5.3.2.5 (12)	R
130	A transponder shelf shall support all types of transponders, or a combination of them. No slot shall be bit-rate specific.	5.5.3.2.5 (13)	R
131	There shall be no human (manual) tuning or intervention (such as power or wavelength adjustment) involved after adding transponders.	5.5.3.2.5 (14)	R
132	A transponder shall support all wavelengths and required transmission rates with a minimum reach of 2000 kilometers without O-E-O regeneration on all specified fiber types (e.g., ITU-T G.652, G.655).	5.5.3.2.5 (15)	R
	5.5.3.2.5.1 Interface Requirements		
133	Transponders shall support an OC-48/STM-16 interface.	5.5.3.2.5.1 (1)	R
134	Transponders shall support an OC192/STM64 interface.	5.5.3.2.5.1 (2)	R
135	Transponders shall support a GigE interface.	5.5.3.2.5.1 (3)	R
136	Transponders shall support a 10GigE WAN PHY interface.	5.5.3.2.5.1 (4)	R
137	Transponders shall support a 10GigE LAN PHY interface.	5.5.3.2.5.1 (5)	R
138	The transponders shall support OC768/STM256 interfaces.	5.5.3.2.5.1 (6)	R
139	The transponder shall support all OTN rates including ODU1/ODU2/ODU3 and 100Gbs in future.	5.5.3.2.5.1 (7)	R
140	The transponders shall support Short Reach (SR), Long Reach (LR-1, LR-2, LR-3), and Intermediate Reach (IR-1, IR-2), client interface types per Telcordia Technologies GR-253-CORE.	5.5.3.2.5.1 (8)	R
141	The transponders shall support client interfaces at 1310 and 1550 nm.	5.5.3.2.5.1 (9)	R
142	The transponders shall support client interface at 850 and 1310 nm for GigE signals.	5.5.3.2.5.1 (10)	R
	5.5.3.2.6 ROADM		
143	The ROADM shall be capable of supporting a minimum of eight network-side interfaces, perform both optical bypass, and add/drop functions.	5.5.3.2.6 (1)	R
144	The ROADM shall support direction-less wavelength routing.	5.5.3.2.6 (2)	R
145	The ROADM shall be capable of colorless wavelength routing.	5.5.3.2.6 (3)	R
146	The system shall support cascading of minimum eight ROADMs for a total un-regenerated reach of 2000 kms.	5.5.3.2.6 (4)	R
147	Any wavelength not explicitly dropped or added shall be passed through the ROADM.	5.5.3.2.6 (5)	R
148	It shall be possible to reuse wavelength at ROADM.	5.5.3.2.6 (6)	R

Table 3-2. OTS Capability/Functional Requirements Table (continued)

ID	Requirement	UCR Ref (UCR 2008 CH 2)	R/C
149	There shall be no restrictions on ADD/DROP and EXPRESS (pass through) wavelengths at ROADM site.	5.5.3.2.6 (7)	R
150	It shall be possible to add/drop, or pass express, any of the optical channels at an ROADM site in any order.	5.5.3.2.6 (8)	R
151	If a wavelength is dropped at an ROADM site, then the same wavelength shall be able to be added at that site. However, there shall be no requirement that the wavelength that is dropped must be matched by a corresponding wavelength that is added, and vice versa, implying wavelength translation capability at the ROADM. At a ROADM it shall be possible to drop an incoming wavelength and not add a new corresponding outgoing wavelength including the following: a. Accepting a non-provisioned incoming wavelength and adding a new outgoing wavelength. b. Dropping an incoming wavelength and adding a new corresponding outgoing wavelength	5.5.3.2.6 (9)	R
152	The ROADM shall be capable of supporting dynamic wavelength selection without pre-cabling being required.	5.5.3.2.6 (10)	R
153	The ROADM shall be capable of dropping all wavelengths from each of eight line-side fiber connections to tributary side optics.	5.5.3.2.6 (11)	R
154	The ROADM shall be capable of adding all wavelengths to each of eight line-side fiber connections from tributary side optics	5.5.3.2.6 (12)	R
155	The ROADM shall be capable of dropping any specific wavelength, independent of other wavelengths to be dropped.	5.5.3.2.6 (13)	R
156	The ROADM shall be capable of adding any specific wavelength, independent of other wavelengths to be added.	5.5.3.2.6 (14)	R
157	The ROADM shall support wavelength hair-pinning capability.	5.5.3.2.6 (15)	R
158	The ROADM shall support wavelength regeneration, including wavelength conversion, using back-to-back transponders or through-transponders via hair pinning.	5.5.3.2.6 (16)	R
159	The activation of additional services on interfaces in the ROADM shall be non-service affecting to existing traffic and shall not cause any increase in bit-errors.	5.5.3.2.6 (17)	R
160	The deletion of active services on interfaces in the ROADM shall be non-service affecting to the remaining traffic and shall not cause any increase in bit-errors.	5.5.3.2.6 (18)	R
161	Hardware upgrades of the ROADM to support higher tributary interface density shall not disrupt operational traffic.	5.5.3.2.6 (19)	R
162	Hardware upgrades of the ROADM to support higher line interface density shall not disrupt operational traffic.	5.5.3.2.6 (20)	R
163	The ROADM shall provide latching capability. (Latching is the ability of the ROADM to maintain its current state in the event of power failure.)	5.5.3.2.6 (21)	R
164	The ROADM shall provide optical multicasting capability. (Multicasting is the ROADM's ability to allow one input wavelength to be duplicated on multiple outputs tributary and line ports).	5.5.3.2.6 (22)	R
165	The ROADM shall support dynamic per-wavelength power leveling.	5.5.3.2.6 (23)	R
166	The addition or deletion of a wavelength service on the ROADM shall not cause an increase in BER or data loss on other wavelengths.	5.5.3.2.6 (24)	R
167	The ROADM shall not incur increased bit errors associated with wavelength provisioning or line equalization.	5.5.3.2.6 (25)	R
168	The failure of an upstream line system shall not cause the ROADM to increase in BER or lose data on the remaining active wavelengths.	5.5.3.2.6 (26)	R
170	The OSNR (optical signal to noise ratio) penalty for any signal passing thru a ROADM shall be < 0.5 dB.	5.5.3.2.6 (27)	R
171	The system is required to automatically redirect working paths to available spare fibers/wavelengths in the event of a primary path failure. The ROADM shall not inhibit ring or linear protection switching initiated by ODXC, MSPP or other electronic device.	5.5.3.2.6 (28)	R
172	The ROADM shall support 1+1 protection functionality with fully diverse routing. The ROADM shall not inhibit ring or linear protection switching initiated by ODXC, MSPP or other electronic device.	5.5.3.2.6 (29)	R
173	The ROADM shall support redirection of light paths via the EMS/NMS.	5.5.3.2.6 (30)	R
174	The ROADM shall support linear protection topologies. The ROADM shall not inhibit ring or linear protection switching initiated by ODXC, MSPP or other electronic device.	5.5.3.2.6 (31)	R

Table 3-2. OTS Capability/Functional Requirements Table (continued)

ID	Requirement	UCR Ref (UCR 2008 CH 2)	R/C
175	The ROADM shall support ring protection topologies. The ROADM shall not inhibit ring or linear protection switching initiated by ODXC, MSPP or other electronic device.	5.5.3.2.6 (32)	R
	5.5.3.2.6.1 ROADM Specific Physical Design Requirements		
176	The vendor shall comply with all requirements listed in General Physical Requirements of this document. The vendor shall list all discrepancies.	5.5.3.2.6.1 (1)	R
177	The ROADM shall support hot swappable modular components, including but not limited to: Fans Switch Fabric Interface Ports Power Supplies Control Processor.	5.5.3.2.6.1 (2)	R
178	The ROADM shall support redundant: Fans Switching Fabrics Power Supplies Control Processors.	5.5.3.2.6.1 (3)	R
179	The ROADM equipment shall be able to fit in either a 19" or a 23" rack with depth no greater than 32" and height no more than 84".	5.5.3.2.6.1 (4)	R
180	The fully configured ROADM (excluding the transponder shelves) shall not exceed two full 84" racks.	5.5.3.2.6.1 (5)	R
181	The fully configured ROADM shall not exceed one full 84" rack.	5.5.3.2.6.1 (6)	R
182	The ROADM shall not require contiguous rack locations.	5.5.3.2.6.1 (7)	R
183	The ROADM weight shall be such that the device can be mountable in a standard Telco™ rack or secure cabinet with standard rack screws and not require unusual hardware.	5.5.3.2.6.1 (8)	R
	5.5.3.2.7 Requirements Common to Transponder and ROADM		
	5.5.3.2.7.1 Framed Formats		
184	The OTS shall support the transport of the following SONET/SDH services: OC-192/STM-64, OC-48/STM-16, and OC-768/STM256.	5.5.3.2.7.1 (1)	R
185	The OTS shall support the transport of the following Ethernet services: GigE (via 10:1 Muxponder), 10GigE WAN PHY, and 10GigE LAN PHY.	5.5.3.2.7.1 (2)	R
186	The OTS shall support the transport of the following OTN services: OTU1, OTU2, and OTU3.	5.5.3.2.7.1 (3)	C
187	The OTS shall be transparent to the bit pattern of all optical channels (i.e., the OTS shall not modify the payload bit pattern of any signal that traverses it).	5.5.3.2.7.1 (4)	R
188	Framed wavelength services shall be supported for 2.5, 10, and 40 Gbps SONET/SDH and OTN transport (ITU-T G.709).	5.5.3.2.7.1 (5)	R
189	Framed wavelength services shall be supported for GigE/10 GigE signals, and signals formatted for OTN transport (ITU-T G.709).	5.5.3.2.7.1 (6)	R
190	Framed wavelength services shall be supported for 40 (ITU-T G.709) and 100 Gbps (STD TBD) signals.	5.5.3.2.7.1 (7)	R
191	The OTS shall support, in hardware and in software, the possibility to feed a specified ITU-T grid wavelength, with undefined framing, directly into the multiplexer through a “colored interface” that shall verify the wavelength and power levels (commonly known as ALIEN wavelength). Identify other characteristics of the tributary signal required to be known and monitored for proper OTS system operation with such tributary signals.	5.5.3.2.7.1 (8)	R
192	Alien wavelength” regeneration shall be supported.	5.5.3.2.7.1 (9	R
	5.5.3.2.7.2 Unframed Formats		
193	The OTS shall support unframed wavelength services.	5.5.3.2.7.2 (1)	R
194	The OTS shall support Mixed Framed Service Unframed Wavelength Service	5.5.3.2.7.2 (2)	R
	5.5.3.2.8 Optical Supervisory Channel		
195	The OTS shall include an OSC linking the two OTS Gateway NEs (GNEs), with access at each OTS OLA site. All telemetry, data, and voice traffic originating at OTS OLA sites shall be routed over this service channel. A diagram of the OSC appears in Figure 5.5.3-2, Optical Supervisory Channel. The optical line rate, the optical format, and interface partitioning internal to the OTS may be a proprietary implementation.		

Table 3-2. OTS Capability/Functional Requirements Table (continued)

ID	Requirement	UCR Ref (UCR 2008 CH 2)	R/C
196	The OLA, ROADM, end terminal (ET) elements shall terminate/insert an Optical Supervisory Channel (OSC) with a wavelength that adheres to ITU-T specifications.	5.5.3.2.8 (1)	R
197	The OLA, ROADM, and ET elements shall utilize the ITU-T specified OSC for out-of-band management communications.	5.5.3.2.8 (2)	R
198	The OLA, ROADM, and ET elements shall use the same OSC wavelength.	5.5.3.2.8 (3)	R
199	The internal diagnostics for OLA, ROADM, and ET elements shall report OSC failure.	5.5.3.2.8 (4)	R
200	It shall be possible to turn-up and sustain transmission between two nodes in the absence of an OSC.	5.5.3.2.8 (5)	R
201	The OLA, ROADM, and ET elements shall report any OSC channel input/output failure (via out-of-band DCN).	5.5.3.2.8 (6)	R
202	The OLA, ROADM, and ET elements shall report any OSC channel BER threshold violation.	5.5.3.2.8 (7)	R
203	The OLA, ROADM, and ET elements shall provide OSC interfaces that allow for interoperability with all adjacent equipment within the optical network (wavelength, modulation, protocol, etc) from the same vendor.	5.5.3.2.8 (8)	R
204	The OSC shall be able to operate error-free across 150 km of each specified fiber type with a span loss of 50 dB at the OSC frequency/wavelength. The span loss shall not be inclusive of the OSC insertion loss.	5.5.3.2.8 (9)	R
205	The OSC circuit-pack shall report optical span-loss between two adjacent nodes.	5.5.3.2.8 (10)	R
206	The OSC shall operate at 2 Mb/s or higher data rates.	5.5.3.2.8 (11)	R
207	Architecturally, the OSC shall be passively and optically separated from the transport optical signals immediately after input connection of the OTS.	5.5.3.2.8 (12)	R
	5.5.3.2.9 OTS Standards Compliance Requirements		
	The standards in effect when the equipment was first acquired are listed. Updates to the standards since that point in time are identified in brackets. When the manufacturer provides new components for the COTS items to the same device that satisfy updated standards, DISA will often purchase and install those components to accommodate growth, but will not replace existing components unless there is another reason to do so. As such, components will be operational within DISN that satisfy multiple versions of the standards. Testing will need to be undertaken using the standard release that applied to that component, where the revised standard cannot be satisfied by the original component.		
208	ITU-T Recommendation G.652 (10/2000) (2005)	5.5.3.2.9 (1)	R
209	ITU-T Recommendation G.655 (10/2000) (2006)	5.5.3.2.9 (2)	R
210	ITU-T Recommendation G-694.1 (2002)	5.5.3.2.9 (3)	R
211	ITU-T Recommendation G.709/Y.1331	5.5.3.2.9 (4)	R
212	ITU-T Recommendation G.825 (2000)	5.5.3.2.9 (5)	R
213	ITU-T Recommendation G.958 (1994), Digital Sections and Digital Line Systems	5.5.3.2.9 (6)	R
214	Telcordia Technologies GR-63-CORE, Issue 1, October 1995 (Issue 3, March 2006)	5.5.3.2.9 (7)	R
215	Telcordia Technologies TR-NWT-000179, Issue 2, June 1993	5.5.3.2.9 (8)	R
216	Telcordia GR-253-CORE, Issue 3, September 2000 (Issue 4, December 2005)	5.5.3.2.9 (9)	R
217	Telcordia Technologies GR-282-CORE, December 1997 (Issue 4, July 2006)	5.5.3.2.9 (10)	R
218	Telcordia Technologies TR-NWT-000295, Issue 2, July 1992	5.5.3.2.9 (11)	R
219	Telcordia Technologies NWT-000418, December 1999	5.5.3.2.9 (12)	R
220	Telcordia Technologies GR-472-CORE, Issue 2, November 1996	5.5.3.2.9 (13)	R
221	Telcordia Technologies FR-796, Reliability and Quality Generic Requirements, Issue 5, April 2008	5.5.3.2.9 (14)	R
222	Telcordia Technologies GR-1089-CORE, Issue 2, Revision 1, February 1999 (Issue 4, June 2006)	5.5.3.2.9 (15)	R
223	Telcordia Technologies SR-NWT-002419, Issue 1, 1992	5.5.3.2.9 (16)	R
224	Telcordia Technologies GR-2911-CORE, 1995	5.5.3.2.9 (17)	R
225	ETSI ETS 300 019, 1994	5.5.3.2.9 (18)	R
226	ETSI ETS-FN-50022	5.5.3.2.9 (19)	R
227	ETSI EN 50082	5.5.3.2.9 (20)	R
228	ETSI EN 300 386	5.5.3.2.9 (21)	R

Table 3-2. OTS Capability/Functional Requirements Table (continued)

ID	Requirement	UCR Ref (UCR 2008 CH 2)	R/C
229	British Standards Institute BS EN 60950-1, August 6, 2006	5.5.3.2.9 (22)	R
230	IEC 60950-1, 2006	5.5.3.2.9 (23)	R
231	Code of Federal Regulations (CFR) FCC Part 15, Class A	5.5.3.2.9 (24)	R
232	Network Equipment - Building System (NEBS), Level 3	5.5.3.2.9 (25)	R
233	Underwriters Laboratories, Inc UL-1950, Standard for Safety, Information Technology Equipment Including Electrical Business Equipment, First Edition 1989	5.5.3.2.9 (26)	R
234	EIA 310C	5.5.3.2.9 (27)	R

LEGEND:

BER	Bit Error Rate	msec	millisecond
dB	Decibel	MSPP	Multiservice Provisioning Platform
C	Conditional	NE	Network Element
DC	Direct Current	NEBS	Network Equipment-Building System
DCN	Data Communications Network	nm	nanometer
DISN	Defense Information Systems Network	OA	Optical Amplifier
DWDM	Dense Wavelength Division Multiplexing	OC	Optical Carrier
EDC	Electronic Dispersion Compensation	ODU	Optical Channel Data Unit
EIA	Electronic Industries Alliance	ODXC	Optical Digital Cross Connect
EMC	Electromagnetic Compatibility	OLA	Optical Line Amplifier
EMI	Electromagnetic Interference	ORL	Optical Return Loss
EOL	End of Life	OSC	Optical Supervisory Channel
FCC	Federal Communications Commission	OSP	Open Shortest Path
FDM	frequency-division multiplexing	OTS	Optical Transport System
GIG-BE	Global Information Grid-Bandwidth Expansion	OXC	Optical Cross Connect
GigE	Gigabit Ethernet	R	Required
GR	Generic Requirement	ROADM	Reconfigurable Optical Add/Drop Multiplexer
IEC	International Electrotechnical Commission	SDH	Synchronous Digital Hierarchy
IEEE	Institute of Electrical and Electronic Engineers	SONET	Synchronous Optical Transport Network
IR	Intermediate Reach	STM	Synchronous Transport Module
ITU	International Telecommunication Union	SUT	System Under Test
ITU-T	International Telecommunication Union-Telecommunication	TTL	Transistor-transistor logic
		UCR	Unified Capabilities Requirement
JITC	Joint Interoperability Test Command	UHF	Ultra high frequency
km	Kilometer	UNI	User Network Interface
LAN	Local Area Network	VHF	Very High Frequency
LoC	Letter of Compliance	WAN	Wide Area Network
Mbps	Megabits per second		

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