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

IN REPLY REFER TO: Joint Interoperability Test Command (JTE) 23 May 2012

MEMORANDUM FOR DISTRIBUTION

SUBJECT: Special Interoperability Test Certification of the Fujitsu FLASHWAVE 4500, Fixed Network Element (F-NE), with Software Release 11.1

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 Fujitsu FLASHWAVE 4500, with Software Release 11.1, is 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 1, 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 approval of the IA configuration. JITC conducted Interoperability testing at the Indian Head, Maryland Test Facility from 22 February through 19 March 2010. The DISA IA Certifying Authority has reviewed the JITC published IA Assessment Report for the SUT, Reference (e), and has provided a positive recommendation of the IA configuration on 3 December 2010. 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 Access Grooming Function under UCR 2008, 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)	UCR Ref (UCR 2008, Change 1)	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	Certified	SUT met requirements for specified interfaces.
	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	Certified	SUT met requirements for specified interfaces.
	OC-X	No	5.9.2.3.8	1, 2, 3, and 4	Certified	SUT met requirements for the following interfaces: OC-3/3C, 12/12C- 48/48C STM-16; and OC-192/STM-64.
	IP (Ethernet) 10/100/GbE	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. The SUT must minimally provide one of the listed ingress and egress interfaces specified.

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)	Ref	Reference
FR	Functional Requirement	STM	Synchronous Transport Module
GbE	Gigabit Ethernet	SUT	System Under Test
IP	Internet Protocol	UCR	Unified Capabilities Requirements

Table 2. SUT CRs and FRs Status

CR/ FR ID	Capability/Function	Applicability (See notes 1 and 2.)	UCR Ref (UCR 2008, Change 1)	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	
Other Tested Requirements					
8	**AGF Requirements**				
	AGF SONET Interface Requirements	Required	5.5.3.4.2	Partially Met	Certified based on sponsor requirements. See note 3.
	AGF SDH Interface Requirements	Required	5.5.3.4.3	Not Met	See note 4.
	AGF Electrical Interface Requirements	Required	5.5.3.4.4	Partially Met	Certified based on sponsor requirements. See note 5.
	AGF Ethernet Interface Requirements	Required	5.5.3.4.5	Partially Met	Certified based on sponsor requirements. See note 6.
	AGF SAN Interface Requirements	Required	5.5.3.4.6	Met	Certified based on sponsor requirements.
	AGF Cross-Connect Requirements	Required	5.5.3.4.7	Partially Met	Certified based on sponsor requirements. See note 7.
	AGF Interface Performance Requirements	Required	5.5.3.4.8	Met	Certified based on sponsor requirements.
	AGF Redundancy Requirements	Required	5.5.3.4.9	Partially Met	Certified based on sponsor requirements. See note 8.

Table 2. SUT CRs and FRs Status (continued)

CR/ FR ID	Capability/Function	Applicability (See notes 1 and 2.)	UCR Ref (UCR 2008, Change 1)	Status	Remarks
8 (cont)	AGF General Protection Requirements	Required	5.5.3.4.10	Met	Certified based on sponsor requirements.
	AGF Interoperability Requirements	Required	5.5.3.4.11	Met	Certified based on sponsor requirements.
	AGF Fault Management Requirements	Required	5.5.3.4.12	Met	Certified based on sponsor requirements.
	AGF Performance Monitoring Requirements	Required	5.5.3.4.13	Partially Met	Certified based on sponsor requirements. See note 9.
	AGF Functional Device Requirements	Required	5.5.3.4.14	Partially Met	Certified based on sponsor requirements. See note 10.
	AGF Functional Device Interface Performance Requirements	Required	5.5.3.4.15	Met	Certified based on sponsor requirements.
	AGF Functional Device EMS Requirements	Required	5.5.3.4.16	Partially Met	Certified based on sponsor requirements. See note 11.
	AGF Physical Design Requirements	Required	5.5.3.4.17	Partially Met	Certified based on sponsor requirements. See note 12.
	AGF Standards Compliance Requirements	Required	5.5.3.4.18	Partially Met	Certified based on sponsor requirements. See note 13.

NOTES:
1. Applicability refers to the high level roll-up of section requirements. A detailed listing of individual requirements applicability is provided in Enclosure 3.
2. The sponsor requested the SUT be assessed against UCR 2008, Section 5.5 as an AGF device.
3. The SUT does not support the following: OC-3 SFP, OC-12 SFP, OC-48 SFP, OC-192 XFP: IR-1, IR-2, LR-1, LR-2, LR-3, and MM.
4. The SUT does not support SDH.
5. The SUT does not support FDL Status Messages.
6. The SUT does not support Transparent VLAN Tagging.
7. The SUT SONET Cross Connect fabric supports only 300 Gbps instead of the required 320 Gbps. The SUT Ethernet Switch fabric does not support the required 20 Gb of IP Switch fabric.
8. The SUT does not support 1:1 redundancy for DS3.
9. The SUT does not support PM capability on all the supported interfaces.
10. The SUT DS1/E-1 Line Terminations does not provide both DS1/E-1 Terminal and Service Loop-Back Capabilities.
11. The SUT EMS does not report Physical Layer (Layer 1) Statistics. The SUT is not able to Provision Circuit Using Different Types Of Cross-Connects.
12. The SUT complies up to 13,000 feet; Low Altitude was not tested.
13. The SUT did not meet the following: the IEEE Standards for LAN and MANs, Virtual Bridged LANs, IEEE 802.1Q-2003, X3-230, ANSI INCITS 374-2003, Information FC-SB-3 and ANSI INCITS 230:1994, Information Technology Fiber Channel Physical and Signaling Interface.

Table 2. SUT CRs and FRs Status (continued)

LEGEND:

802.1Q-2003	The networking standard that supports Virtual LANs on an Ethernet network , 2003 Edition	IPv6	Internet Protocol version 6
ADPCM	Adaptive Differential Pulse Code Modulation	IR	Infrared
AGF	Aggregation Grooming Function	ITU-T	International Telecommunications Union - Telecommunications
ANSI	American National Standards Institute	Kbps	Kilobits per second
CR	Capability Requirement	LAN	Local Area Network
CS-ACELP	Conjugate Structure Algebraic Code-Excited Linear Prediction	LD-CELP	Low Delay-Code Excited Linear Prediction
DLoS	Direct Line of Sight	LR	Long Reach
DS	Digital Signal	MAN	Metropolitan Area Network
E1	European Interface Standard (2.048 Mbps)	MM	Multiplexor Module
EMS	Element Management System	NA	Not Applicable
F-NE	Fixed Network Element	NE	Network Element
FC-SB-S3	Fiber Channel- Single-Byte Command Code Sets Mapping Protocol 3	NM	Network Management
FDL	Fiber Delay Line	NMS	Network Management System
FR	Functional Requirement	OC	Optical Carrier
Gb	Gigabit	PM	Power Management
G.726	ITU-T speech codec for ADPCM (32 Kbps)	Ref	Reference
G.728	ITU-T speech codec for LD-CELP (16 Kbps)	SAN	Storage Area Network
G.729	ITU-T speech codec for CS-ACELP (8 Kbps)	SDH	Secure Digital Host
Gbps	Gigabits per second	SFP	Small Form Factor
ID	Identification	SONET	Synchronous Optical Network
IEEE	Institute of Electrical and Electronics Engineers	SUT	System Under Test
INCITS	International Committee for Information Technology Standards	UCR	Unified Capabilities Requirements
IP	Internet Protocol	VLAN	Virtual Local Area Network
IPv4	Internet Protocol version 4	VVoIP	Voice and Video over Internet Protocol
		X3-230	Processor number
		XFP	Small Form Factor

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 Unified Capabilities Certification Office (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 (TN) is 0928102.

FOR THE COMMANDER

3 Enclosures a/s

RICHARD A. MEADOR
Chief
Battlespace Communications Portfolio

JITC Memo, JTE, Joint Interoperability Test Certification of the Fujitsu FLASHWAVE 4500, Fixed Network Element (F-NE), with Software Release 11.1

Distribution (electronic mail):
Joint Staff J-6
Joint Interoperability Test Command, Liaison, TE3/JT1
Office of Chief of Naval Operations, CNO N6F2
Headquarters U.S. Air Force, Office of Warfighting Integration & CIO, AF/XCIN (A6N)
Department of the Army, Office of the Secretary of the Army, DA-OSA CIO/G-6 ASA (ALT), SAIS-IOQ
U.S. Marine Corps MARCORSYSCOM, SIAT, MJI Division I
DOT&E, Net-Centric Systems, and Naval Warfare
U.S. Coast Guard, CG-64
Defense Intelligence Agency
National Security Agency, DT
Defense Information Systems Agency, TEMC
Office of Assistant Secretary of Defense (NII)/DoD CIO
U.S. Joint Forces Command, Net-Centric Integration, Communication, and Capabilities Division, J68
HQUSAISEC, AMSEL-IE-IS

ADDITIONAL REFERENCES

(c) Office of the Assistant Secretary of Defense Document, "Department of Defense Unified Capabilities Requirements 2008, Change 1," January 2010
(d) Joint Interoperability Test Command Document, "Unified Capabilities Interoperability Test Plan," January 2010
(e) Joint Interoperability Test Command, "Information Assurance (IA) Assessment of Fujitsu Network Communications, Inc. FLASHWAVE 4500 Fixed Network Element (F-NE), Software Release 11.1, (TN 0928102)," 3 December 2010

(This page intentionally left blank.)

CERTIFICATION TESTING SUMMARY

1. SYSTEM TITLE. Fujitsu FLASHWAVE 4500, Fixed Network Element (F-NE), with Software Release 11.1.

2. SPONSOR. United States Army, Mr. Steve Pursell, Address: AMSEL-IE-IS, Bldg 53301, Fort Huachuca, Arizona, 85613-5300, e-mail: steven.d.pursell.civ@mail.mil

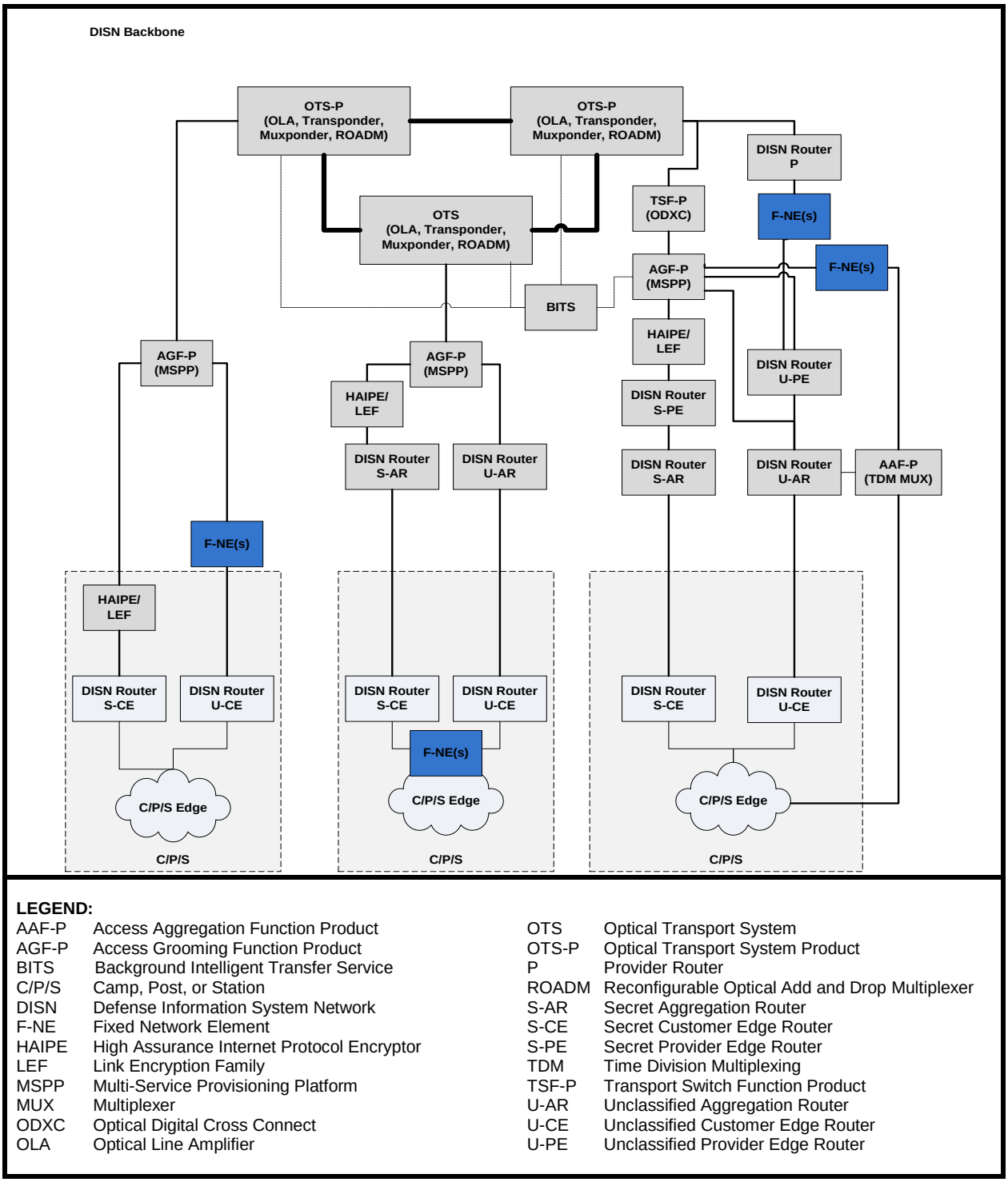
3. SYSTEM POC. Ms. Cathy Simon, Fujitsu, Address: 2801 Telecom Parkway, Richardson, TX 75082, e-mail: cathy.simon@us.fujitsu.com

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

5. SYSTEM DESCRIPTION. The Fujitsu FLASHWAVE 4500, with Software Release 11.1, hereinafter referred to as the System Under Test (SUT) is a F-NE product that receives low-speed circuits on multiple ingress ports and multiplexes them together onto higher speed egress interfaces. The SUT allows for internal cross-connects between the low-speed ports and the high-speed ports. The SUT can connect circuits from any port to any other port within the bandwidth limitations of the ports.

The SUT provides a unified platform for both packet and Synchronous Optical Network (SONET) derived services. The SUT allows convergence of data, synchronous networks, and asynchronous networks in the Department of Defense (DoD).

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	Optical Transport System
OTS-P	Optical Transport System Product
P	Provider Router
ROADM	Reconfigurable Optical Add and Drop Multiplexer
S-AR	Secret Aggregation Router
S-CE	Secret Customer Edge Router
S-PE	Secret Provider Edge Router
TDM	Time Division Multiplexing
TSF-P	Transport Switch Function Product
U-AR	Unclassified Aggregation Router
U-CE	Unclassified Customer Edge Router
U-PE	Unclassified Provider Edge Router

Figure 2-1. DISN Architecture

7. INTEROPERABILITY REQUIREMENTS. The interface, Capability Requirements (CR), Functional Requirements (FR), Information Assurance, and other requirements for F-NE products are established by Sections 5.4 and 5.9 of the DoD UCR 2008, Change 1.

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

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

Table 2-3. Other SUT Interface Requirements

Interface	Criteria	Remarks
DS1	Meet Commercial interface standards and sponsor information exchange requirements.	UCR specifies minimum requirements. These requirements represent the sponsors additional interfaces desired for fielding in US and Europe.
DS3		
10 Mbps Ethernet		
100 Mbps Ethernet		

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	Mbps	Megabits per second
DS1	Digital Signal Level 1 (1.544 Mbps)	SUT	System Under Test
DS3	Digital Signal Level 3 (44.736 Mbps)	UCR	Unified Capabilities Requirements
FR	Functional Requirements	US	United States

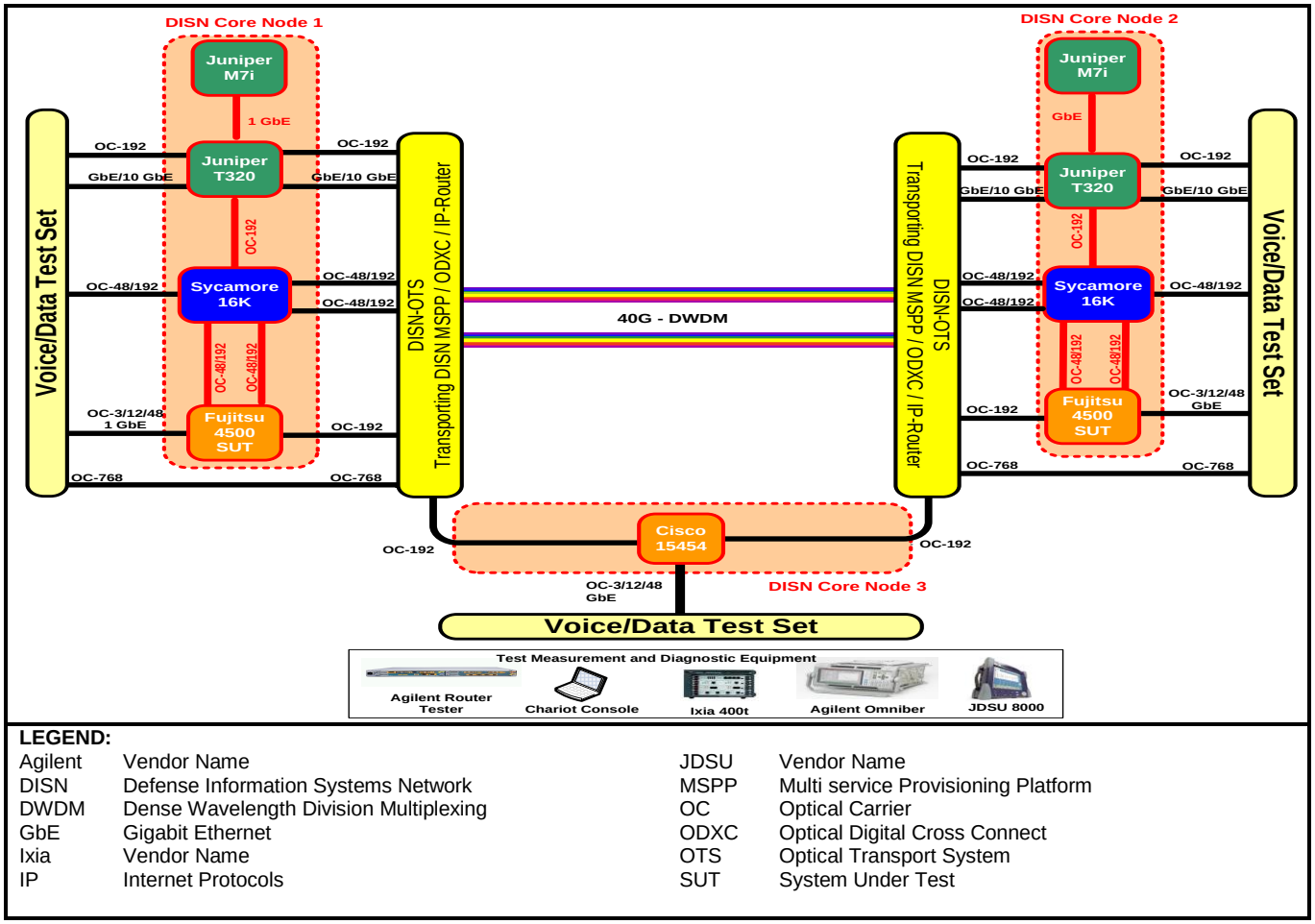
Table 2-4. Other CR/FR Requirements

CR/FR ID	Capability/Function	Applicability	UCR Ref (UCR 2008, Change 1)	Criteria	Remarks
Other Requirements					
8	AGF SONET Interface Requirements	Conditional	5.5.3.4.2	Meet Sponsor requirements	
	AGF Electrical Interface Requirements	Conditional	5.5.3.4.4	Meet Sponsor requirements	
	AGF Ethernet Interface Requirements	Conditional	5.5.3.4.5	Meet Sponsor requirements	
	AGF Cross-Connect Requirements	Conditional	5.5.3.4.7	Meet Sponsor requirements	
	AGF Interface Performance Requirements	Conditional	5.5.3.4.8	Meet Sponsor requirements	
	AGF Redundancy Requirements	Conditional	5.5.3.4.9	Meet Sponsor requirements	
	AGF General Protection Requirements	Conditional	5.5.3.4.10	Meet Sponsor requirements	
	AGF Interoperability Requirements	Conditional	5.5.3.4.11	Meet Sponsor requirements	
	AGF Fault Management Requirements	Conditional	5.5.3.4.12	Meet Sponsor requirements	
	AGF Performance Monitoring Requirements	Conditional	5.5.3.4.13	Meet Sponsor requirements	
	AGF Functional Device Interface Performance Requirements	Conditional	5.5.3.4.15	Meet Sponsor requirements	
	AGF Physical Design Requirements	Conditional	5.5.3.4.17	Meet Sponsor requirements	
	AGF Standards Compliance Requirements	Conditional	5.5.3.4.18	Meet Sponsor requirements	

LEGEND:

AGF	Access Grooming Function	Ref	Reference
CR	Capabilities Requirement	SONET	Synchronous Optical Network
FR	Functional Requirement	UCR	Unified Capabilities Requirements
ID	Identification		

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



LEGEND:

Agilent	Vendor Name	JDSU	Vendor Name
DISN	Defense Information Systems Network	MSPP	Multi service Provisioning Platform
DWDM	Dense Wavelength Division Multiplexing	OC	Optical Carrier
GbE	Gigabit Ethernet	ODXC	Optical Digital Cross Connect
Ixia	Vendor Name	OTS	Optical Transport System
IP	Internet Protocols	SUT	System Under Test

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

SYSTEM NAME	SOFTWARE RE-LEASE	UC Product
FLASHWAVE 4500	Release 11.1	F-NE
NetSmart 500 EMS. See note.	Release 3.12.0	F-NE
NetSmart 1500 NMS. See note.	Release 6.0.0	F-NE
CARD NAME	**PART NUMBER**	**Quantity**
12 Port Multi rate SFP based unit	FC9580MRC1	2
High Order VCAT GbE TPORT unit SX	FC9580HTS1	1
Low Order VCAT GbE TPORT unit SX	FC9580LTS1	1
OC-3 IR1 SFP	FC95700021	2
OC-12 IR1 SFP	FC95700051	2
OC-48 IR1 SFP	FC95700090	2
CWDM SFP 1591 OC3/12/48	FC9570B40B	2
2 port GbE Short Reach (LCAS)	FC9580GSL5	1
FW4500 HD Optical Shelf (Octal units, opens to the left)	FC9580HAS1	1
4-meter MPO/LC conversion cable	FC9580JPR1	2
10/100BaseT unit w/ LCAS, 4 port	FC9580FTX5	1
2-port 100BaseFX MMF w-LCAS	FC9580FFX6	1
2-port 100BaseLX SMF w-LCAS	FC9580FLX6	1
High Order VCAT GbE TPORT unit LX	FC9580HTL1	1
Low Order VCAT GbE TPORT unit LX	FC9580LTL1	1
Octal Port OC-12	FC9580M2C7	2
2 port GbE Long Reach (LCAS)	FC9580GLL5	1
2 port GbE Ultra Reach (LCAS)	FC9580GZL5	1
28port DS1	FC9580D1V3	4
8 PORT DS3/EC1 INTERFACE UNIT	FC9580D3S1	4
DS3/EC1 SWITCH	FC9580DSW1	2
FW4500 FAN UNIT	FC9580FAN2	8
FW4500 2 port 100BaseLX SMF (LCAS)	FC9580FLX5	2
FILLER PANEL (LARGE SLOT)	FC9580FP11	15
FILLER PANEL (SMALL SLOT)	FC9580FP21	16
10/100BT 4 port, RJ-45	FC9580FTX3	2
OC192 C-band NB FBTL	FC9580G9C1	4
1000BaseLX GbE LC connector	FC9580GLL3	2
FW4500 2 port GbE Long Reach (LCAS)	FC9580GLL5	2
FW4500 HD Optical Shelf (Octal units)	FC9580HAS1	2
FW4500 HUB3	FC9580HUB3	2
FW4500 4m Jumper kit (Octal OC-n units)	FC9580JPR1	8
OC-12, Quad Port,1310nm LR, LC type SMF	FC9580L2C5	4
OC-3, Quad Port,1310nm IR/LR, LC type SM	FC9580L3F5	4
Dual OC48 SR 1310nm	FC9580L8B3	4
FW4500 Octal Port OC-12	FC9580M2C7	4
FW4500 Octal Port OC-3	FC9580M3C7	4
70G (1344 x 1344) STS SF	FC9580SF21	4
FW4500 140Gb STS Switch Fabric	FC9580SF33	4
FLASHWAVE 4500 Shelf 2 (DS1 Support)	FC9580SHF2	2
TIMING UNIT, TCA2-ST31	FC9580ST31	4
M13 Transmax 12port	FC9580TMX1	4

Table 2-5. Tested System Configuration (Continued)

FW4500 VT SWITCH FABRIC 1344x1344	FC9580VF11	4
CA ASSY,24 AWG,28PR,SHLD,64PM AMP/STUB	21-372-025	2
CA ASSY,24AWG,28PR,SHLD,64PM,135 RT EX	21-375-025	4
CA ASSY,24AWG,28PR,SHLD,64PM180/M180	21-377-005	2
CA ASSY,24AWG,28PR,SHLD,64PM180/M180	21-377-010	10
CA ASSY KIT,8AWG BLK,8AWG RED,8AWG GRN	22-043-015	3
CA ASSY,KIT,FLM/ADM,POWER,UNIVERSAL	22-515-015	1
FBR JMPR,1-FBR,SM,LC/LC	27-100-002	70
FBR JMPR,1-FBR,SM,LC/LC	27-100-007	8
FBR JMPR,1-FBR,MM,LC/LC,2.0MM RISER	27-1M002MM-005	8
CIRCUIT BREAKER PANEL	HA15B-0001-B299/02	3
FLASHWAVE 320Gb/4500 TERMINAL RACK CB KIT	HA15B-0001-C350	2
CKT BKR KIT - FLASH 600ADX	HA15B-0001-C366	5
KIT, PCB, ECWW ADAPTER	HA15B-0001-D188	1
DS1/DS3 PATCH PANEL	PC15L-0001-C074#02	5
OC-192, WB, 1310nm	FC9580L9B1	2
Preloaded Rls 11.1 S/W MPA-CPU2	PL-MPA450M-R1110	1
Preloaded Rls 11.1 S/W DCA-DCC2	PL-DCA450M-R1110	1
FW4500 R11.1 Software	FC9580CR11-I01	1

NOTE: Only used for configuration purposes and is not certified under the SUT.

LEGEND:

10Base-T	10 Mbps Ethernet generic designation	LCAS	Link Capacity Adjustment Scheme
100 Base-T	100 Mbps Ethernet generic designation	LR	Long Reach
ADM	Add/Drop Multiplexer	LX	Local Exchange
ADX	Average Directional Index	m	Meter
AMP	Amplifier	M	Model
ASSY	Assembly	MM	Multi Mode
AWG	Array Waveguide Gratings	MMF	Multi Mode Fiber
BKR	Breaker	MPA	Message Passing Algorithm
BLK	Black	MPO	Multipath Optical
CA	Cable	NB	Nonabyte
CB	Circuit Breaker	nm	nanometer
CKT	Circuit	NMS	Network Management System
CPU	Central Processing Unit	OC	Optical Carrier
CWDM	Coarse Wavelength Division Multiplexing	PCB	Power Control Bit
DCA	Digital Communications Analyzer	PM	Power Management
DCC	Data Communications Channel	PR	Pulse Rate
DS	Digital Signal	RJ-45	Ethernet Cable
EC	Error Correction	Rls	Release
ECWW	External Clock Wire Wrap	RT	Right
EMS	Element Management System	SF	Switch Fabric
EX	Exit	SFP	Small Form Factor Pluggable
FBR	Fiber	SHLD	Shield
FBTL	Full Band Tunable Laser	SMF/SM	Single Mode Fiber
FLM	Fiber Loop Multiplexer	STUB	Cable Type
F-NE	Fixed-Network Element	STS	Synchronous Transport Signal
FX	Full Duplex	SUT	System Under Test
FW	Flashwave	SR	Short Reach
Gb	Gigabit	SX	System Extension
GbE	Gigabit Ethernet	S/W	Software
GRN	Green	TPORT	Twisted Pair Port Transceiver
HD	High Definition	VCAT	Virtual Concatenation
IR	Intermediate Reach	VT	Virtualization Technology
JMPR	Jumper	WB	Wide Band
LC	Link Capacity		

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 GbE LAN 1000 Base X, 1x OC-192 SM SR2, 1 x 10GbE LAN, XENPAK
Juniper M7i	10.3.R4.4	4 x GbE LAN
DISN-OTS (CN-4200)	R7.2.0	SONET-OC-48, Ethernet 1GbE, OTN-OTU-1, DWDM-CWDM

LEGEND:

1000 Base-X	1000 Mbps Ethernet generic designation	Mbps	Megabits per second
100 Base-X	100 Mbps Ethernet generic designation	OC	Optical Carrier
CWDM	Coarse Wavelength Division Multiplexing	ODXC	Optical Digital Cross Connect
DISN	Defense Information Systems Network	OTN	Optical Transport Network
DS	Digital Signal	OTS	Optical Transport System
DWDM	Dense Wavelength Division Multiplexing	OTU	Optical Channel Transport Unit
ETH	Ethernet	R	Revision
FE	Fast Ethernet	SM	Single Mode
FX	Fast Ethernet over Fiber Cable	SONET	Synchronous Optical Network
GbE	Gigabit Ethernet	SR	Short Reach
GPIC	Gigabit Port Interface Controller	STM	Synchronous Transport Module
IR	Intermediate Reach	SUT	System Under Test
LAN	Local Area Network	TX	Fast Ethernet over Twisted Wires
LIM	Line Interface Module	USC	Universal Services Card
LR	Long Reach	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	
Digital Lightwave	Optical Wavelength Manager	Monitor Ports	2.4.0
Adtech AX4000	Optical Tester	1310 nm	6.0.r20
JDSU	T-Berd 8000	OC-192 POS	6.11
		DSU	6.4
		10/100/1000	
		OC-3-12	
		DS-3	
		OC-192	

LEGEND:

1000 Base-X	1000 Mbps Ethernet generic designation	Mbps	Megabits per second
DS	Digital Signal	nm	nanometer
DSU	Data Services Unit	OC	Optical Carrier
JDSU	Vendor Name	POS	Packet Over Synchronous Optical Network

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 Change 1)	Status	Remarks
NE	Analog	No	5.9.2.3.1	NA	Not supported by the SUT
	Serial	No	5.9.2.3.2	NA	Not supported by the SUT
	BRI ISDN	No	5.9.2.3.3	NA	Not supported by the SUT
	DS1	No	5.9.2.3.4	Certified	SUT met requirements for specified interfaces
	E1	No	5.9.2.3.5	NA	Not supported by the SUT
	DS3	No	5.9.2.3.6	Certified	SUT met requirements for specified interfaces
	OC-X	No	5.9.2.3.8	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/GbE	No	5.9.2.3.9	Certified	SUT met requirements for specified interfaces
NM	10Base-X	Yes	5.3.2.4.4	Certified	SUT met NM requirements for specified interfaces
	100Base-X	Yes	5.3.2.4.4	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
CH	Change	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)	Ref	Reference
F-NE	Fixed Network Element	STM	Synchronous Transport Module
GbE	Gigabit Ethernet	SUT	System Under Test
IP	Internet Protocol	UCR	Unified Capabilities Requirements

11.2 CRs and FRs. 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 1)	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	

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	ITU-T	International Telecommunication Union - Telecommunication
CR	Capabilities Requirement	Kbps	Kilobits per second
CS-ACELP	Conjugate Structure Algebraic Code-Excited Linear Prediction	LD-CELP	Low Delay-Code Excited Linear Prediction
DLoS	Direct Line of Sight	NA	Not Applicable
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)	Ref	Reference
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
IPv6	Internet Protocol version 6		

a. General NE Requirements

(1) General Requirements. In accordance with (IAW) UCR 2008, Change 1, 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 1, 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 Kilobits per second (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 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 DISN 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 E2E 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 millisecond (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) Internet Protocol (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 requirements are applicable to the SUT, instead those are the 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. 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 DISN 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 1, 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 Defense Information Systems Agency VVoIP Element Network Management (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 1, 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-1, 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 conducted additional tests on the SUT. The SUT's CR/FR status under UCR 2008, Change 1, Section 5.5.3.4, and the results under Aggregation Grooming Function (AGF) requirements are listed in Table 2-10.

The SUT met the minimum standards for the UCR 2008, Change 1, Section 5.5.3.4, with the following exceptions:

a. AGF SONET Interface Requirements: – Sub-Paragraphs: (5.5.3.4.2).4, .5, .6, .7, .8, .13, .15, .16, .17, .22, .25, .31, .32, .33, .35
b. AGF SDH Interface Requirements – Sub-Paragraphs: (5.5.3.4.3).1-.29, 5.5.3.4.3.1.1-.2
c. AGF Electrical Interface Requirements – Sub-Paragraphs: (5.5.3.4.4).6-.7
d. AGF Ethernet Interface Requirements – Sub-Paragraph: (5.5.3.4.5).6
e. AGF Cross-Connect Requirements – Sub Paragraphs: (5.5.3.4.7).2, .5
f. AGF Redundancy Requirements – Sub-Paragraph: (5.5.3.4.9).3
g. AGF Performance Monitoring Requirements – Sub-Paragraph: (5.5.3.4.13).1
h. AGF Functional Device Requirements – Sub-Paragraph: (5.5.3.4.14).14
i. AGF Functional Device EMS Requirements – Sub-Paragraphs: (5.5.3.4.16).1, .3
j. AGF Physical Design Requirements – Sub-Paragraph: (5.5.3.4.17).8
k. AGF Standards Compliance Requirements – Sub-Paragraphs: (5.5.3.4.18).32-.33

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

Table 2-10. Other CRs and FRs

CR/FR ID	Capability/Function	UCR Ref (UCR 2008, Change 1)	Status	Remarks
8	AGF SONET Interface Requirements	5.5.3.4.2	Partially Met	See note 1.
	AGF SDH Interface Requirements	5.5.3.4.3	Not Met	See note 2.
	AGF Electrical Interface Requirements	5.5.3.4.4	Partially Met	See note 3.
	AGF Ethernet Interface Requirements	5.5.3.4.5	Partially Met	See note 4.
	AGF SAN Interface Requirements	5.5.3.4.6	Met	
	AGF Cross-Connect Requirements	5.5.3.4.7	Partially Met	See note 5.
	AGF Interface Performance Requirements	5.5.3.4.8	Met	
	AGF Redundancy Requirements	5.5.3.4.9	Partially Met	See note 6.
	AGF General Protection Requirements	5.5.3.4.10	Met	
	AGF Interoperability Requirements	5.5.3.4.11	Met	
	AGF Fault Management Requirements	5.5.3.4.12	Met	
	AGF Performance Monitoring Requirements	5.5.3.4.13	Partially Met	See note 7.
	AGF Functional Device Requirements	5.5.3.4.14	Partially Met	See note 8.
	AGF Functional Device Interface Performance Requirements	5.5.3.4.15	Met	
	AGF Functional Device EMS Requirements	5.5.3.4.16	Partially Met	See note 9.
	AGF Physical Design Requirements	5.5.3.4.17	Partially Met	See note 10.
	AGF Standards Compliance Requirements	5.5.3.4.18	Partially Met	See note 11.

NOTES:
1. The SUT does not support the following: OC-3 SFP, OC-12 SFP, 48 SFP, OC-192 XFP: IR-1, IR-2, LR-1, LR-2, LR-3, and MM.
2. The SUT does not support SDH.
3. The SUT does not support FDL Status Messages.
4. The SUT does not support Transparent VLAN Tagging.
5. The SUT SONET Cross Connect fabric supports only 300 Gbps instead of the required 320 Gbps. The SUT Ethernet Switch fabric does not support the required 20Gb of IP Switch fabric.
6. The SUT does not support 1:1 redundancy for DS3.
7. The SUT does not support PM capability on all the supported interfaces.
8. The SUT DS1/E-1 Line Terminations does not provide both DS1/E-1 Terminal and Service Loop-Back Capabilities.
9. The SUT EMS does not report Physical Layer (Layer 1) Statistics. The SUT is not able to Provision Circuit Using Different Types Of Cross-Connects.
10. The SUT complies up to 13,000 feet; Low Altitude was not tested.
11. The SUT did not meet the following: the IEEE Standards for LAN and MANs, Virtual Bridged LANs, IEEE 802.1Q-2003, X3-230, ANSI INCITS 374-2003, Information FC-SB-3 and ANSI INCITS 230:1994, Information Technology Fiber Channel Physical and Signaling Interface.

Table 2-10. Other CRs and FRs (continued)

LEGEND:

802.1Q-2003	The networking standard that supports Virtual LANs on an Ethernet network , 2003 Edition	IR	Intermediate Reach
AGF	Aggregation Grooming Function	LAN	Local Area Network
ANSI	American National Standards Institute	LR	Long Reach
CR	Capability Requirement	MAN	Metropolitan Area Networks
DS	Digital Signal	MM	Multiplexor Module
E1	European-Carrier 1	OC	Optical Carrier
EMS	Element Management System	PM	Power Management
FC-SB-3	Fiber Channel Single-Byte Command Code Sets Mapping Protocol 3	Ref	Reference
FDL	Fiber Delay Line	SAN	Storage Area Network
FR	Functional Requirement	SB	Single Byte
Gb	Gigabit	SDH	Secure Digital Host
Gbps	Gigabits per second	SFP	Small Form Factor
ID	Identification	SONET	Synchronous Optical Network
IEEE	Institute of Electrical and Electronics Engineers	SUT	System Under Test
IP	Internet Protocol	UCR	Unified Capabilities Requirements
INCITS	International Committee for Information Technology Standards	VLAN	Virtual Local Area Network
		XFP	Small Form Factor
		X3-230	Processor number

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 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 F-NE are listed in Table 3-1.

Table 3-1. F-NE Capability/Functional Requirements Table

ID	Requirement	UCR Ref (UCR 2008 CH 1)	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 1)	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 1)	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 1)	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 1-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 carry signaling information.	5.9.2.3.4 (2)	C

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

ID	Requirement	UCR Ref (UCR 2008 CH 1)	F-NE
	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 1-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 1-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 1-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 requirements as described in the Telcordia Technologies GR-518-CORE, Paragraph 18.2.	5.9.2.3.7	R

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

ID	Requirement	UCR Ref (UCR 2008 CH 1)	F-NE
	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: (1) [Required: Data Interface] The NE shall provide network management (NM) data/monitoring via one or more of the following physical interfaces:	5.9.2.4.1	R

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

ID	Requirement	UCR Ref (UCR 2008 CH 1)	F-NE
	** 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
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

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

ID	Requirement	UCR Ref (UCR 2008 CH 1)	F-NE
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:

ANSI	American National Standards Institute	ISDN	Integrated Services Data Network
AP	Association Path	ITU	International Telecommunications Union
APL	Approved Product List	ITU-T	ITU Telecommunications Union - Telecommunications Sector
ASLAN	Assured Services LAN		
AS-SIP	Assured Services Session Initiation Protocol	Kbps	Kilobits per second
		LAN	Local Area Network
B8ZS	Bipolar with Eight-Zero Substitution	MAN	Metropolitan Area Networks
BER	Bit Error Rate	MLPP	Multi-Level Precedence and Preemption
BRI	Basic rate Interface	MOS	Mean Opinion Score
C	Conditional	Ms	Millisecond
CE	Customer Edge	NMS	Network Management System
CGA	Carrier Group Alarm	NSA	National Security Agency
CH	Change	P2N	Point-to-Network
COT	Continuity Testing	P2NP	Point-to-Network-Point
D-NE	Deployed-Network Element	P2MP	Point-to Multipoint
DAA	Designated Approving Authority	P2P	Point-to-Point
DF	Default	PCM	Pulse Code Modulation
DISR	DoD Information technology Standards and Profile Registry	PKI	Public Key Infrastructure
		PRI	Primary rate Interface
DLoS	Direct Line of Sight	QoS	Quality of Service
DoD	Department of Defense	R	Required
DoDI	DoD Instruction	Ref	Reference
DS	Digital Signal	SCIP	Secure Communication Interoperability Protocol
DSN	Defense Switched Network	SONET	Synchronous Optical Network
DVX	Deployed Voice Exchange	SRTP	Secure Real-Time Protocol
E1	European 1 (2048 bps, 30-channel PCM)	STIG	Security Technical implementation Guide
E2E	End to End	T1	Trunk 1 (1544 bps, 24-channel PCM)
F-NE	Fixed-Network Element	TCP	Transmission Control Protocol
FIPS	Federal Information Processing Standard	TDM	Time Division Multiplexing
Hz	Hertz	TIA	Telecommunications Industry Association
HMAC-SHA1	Secure cryptographic hash algorithm published by the United States Government	TLS	Transport Layer Security
		UCCO	Unified Capabilities Certification Office
		UCR	Unified Capabilities Requirements
IAW	In Accordance With	VVoIP	Voice and Video over Internet Protocol
IP	Internet Protocol	WIDS	Wireless Intrusion Detection System
IPSec	Internet Protocol Security		

AGGREGATION GROOMMING FUNCTION (AGF) SYSTEM FUNCTIONAL AND CAPABILITY REQUIREMENTS

The AGF products 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 AGF products are listed in Table 3-2. Detailed Information Assurance (IA) requirements are included in Reference (e) and are not listed below.

Table 3-2. AGF Capability/Functional Requirements Table

ID	Requirement	UCR Ref (UCR 2008 CH1)	R/C
1	The OC-3/OC-3c optical interface shall conform to the standard SONET rates and formats documented in ANSI T1.105.	5.5.3.4.2 (1)	R
2	The OC-3/OC-3c optical interface shall conform to optical parameters for application category SR-1 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (2)	R
3	The OC-3/OC-3c optical interface shall conform to optical parameters for application category IR-1 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (3)	R
4	The OC-3/OC-3c optical interface shall conform to optical parameters for application category IR-2 per Telcordia Technologies, GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (4)	R
5	The OC-3/OC-3c optical interface shall conform to optical parameters for application category LR-1 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (5)	R
6	The OC-3/OC-3c optical interface shall conform to optical parameters for application category LR-2 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (6)	R
7	The OC-3/OC-3c optical interface shall conform to optical parameters for application category LR-3 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (7)	R
8	The OC-3/OC-3c interfaces shall be capable of having a multi-mode fiber (MMF) interface option for both transmit and receive using MMF as described in ITU-T Recommendation G.651 and ANSI 105.06-2002.	5.5.3.4.2 (8)	D
9	The OC-3/OC-3c interfaces shall be capable of using Single Mode Fiber (SMF) as described in ITU-T Recommendation G.652 and ANSI 105.06-2002.	5.5.3.4.2 (9)	R
10	The OC-12/OC-12c optical interface shall conform to the standard SONET rates and formats documented in ANSI T1.105.	5.5.3.4.2 (10)	R
11	The OC-12/OC-12c optical interface shall conform to optical parameters for application category SR-1 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (11)	R
12	The OC-12/OC-12c optical interface shall conform to optical parameters for application category IR-1 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (12)	R
13	The OC-12/OC-12c optical interface shall conform to optical parameters for application category IR-2 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (13)	R
14	The OC-12/OC-12c optical interface shall conform to optical parameters for application category LR-1 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (14)	R
15	The OC-12/OC-12c optical interface shall conform to optical parameters for application category LR-2 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (15)	R
16	The OC-12/OC-12c optical interface shall conform to optical parameters for application category LR-3 per Telcordia Technologies GR-253-CORE Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (16)	R

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

ID	Requirement	UCR Ref (UCR 2008 CH1)	Required (R)/ Conditional (C)
17	The OC-12/OC-12c interfaces shall be capable of having an MMF interface option for both transmit and receive using MMF as described in ITU-T Recommendation G.651 and ANSI 105.06-2002.	5.5.3.4.2 (17)	D
18	The OC-12/OC-12c interfaces shall be capable of using SMF as described in ITU-T Recommendation G.652 and ANSI 105.06-2002.	5.5.3.4.2 (18)	R
19	The OC-48/OC-48c optical interface shall conform to the standard SONET rates and formats documented in ANSI T1.105.	5.5.3.4.2 (19)	R
20	The OC-48/OC-48c optical interface shall conform to optical parameters for application category SR-1 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (20)	R
21	The OC-48/OC-48c optical interface shall conform to optical parameters for application category IR-1 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (21)	R
22	The OC-48/OC-48c optical interface shall conform to optical parameters for application category IR-2 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (22)	R
23	The OC-48/OC-48c optical interface shall conform to optical parameters for application category LR-1 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (23)	R
24	The OC-48/OC-48c optical interface shall conform to optical parameters for application category LR-2 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (24)	R
25	The OC-48/OC-48c optical interface shall conform to optical parameters for application category LR-3 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (25)	R
26	Software programmable SFP that supports OC-3/OC-12 optical interface shall conform to optical parameters for application category per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (26)	D
27	Programmable SFP that supports OC-3/OC-3c and OC-12/OC-12c optical interfaces shall be capable of having an MMF interface option for both transmit and receive using MMF as described in ITU-T Recommendation G.651 and ANSI 105.06-2002.	5.5.3.4.2 (27)	D
28	Software programmable SFP that supports OC-3/OC-12/OC-48 and OC-3c/OC12c/OC-48c optical interface shall conform to optical parameters for application category per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (28)	D
29	The OC-192 optical interface shall conform to the standard SONET rates and formats documented in ANSI T1.105.	5.5.3.4.2 (29)	R
30	The OC-192 optical interface shall conform to optical parameters for application category SR-1 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (30)	R
31	The OC-192 optical interface shall conform to optical parameters for application category IR-1 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (31)	R
32	The OC-192 optical interface shall conform to optical parameters for application category IR-2 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (32)	R
33	The OC-192 optical interface shall conform to optical parameters for application category LR-1 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (33)	R
34	The OC-192 optical interface shall conform to optical parameters for application category LR-2 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (34)	R
35	The OC-192 optical interface shall conform to optical parameters for application category lR-3 per Telcordia Technologies GR-253-CORE, Sections 4.1 and 4.2, and Tables 4-1 through 4-11.	5.5.3.4.2 (35)	R
36	The OC-768 optical interface shall conform to the standard SONET rates and formats documented in ANSI T1.105.	5.5.3.4.2 (36)	D
37	All SONET OC-N interfaces shall be software-provision to SDH STM-N.	5.5.3.4.2 (37)	D

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

ID	Requirement	UCR Ref (UCR 2008 CH1)	Required (R)/ Conditional (C)
38	The software has to provide options for the OC-3 through OC-48 optical interfaces and the upgrade capability to the next higher optical rate by changing cards unless the optics is software programmable. If the optics is software programmable, then this capability must be allowed by changing the software setting to the next higher rate. Both procedures must preserve the customer data provisioned on the optical interface and move to the equivalent bandwidth slot starting at the beginning STS. Example: OC-3 upgrade to OC-12, OC-12 to OC-48, and OC-48 to OC-192. Customer provisioned on OC-3 (STS-1 through 3) will occupy STS-1 through 3 on the OC-12 after the upgrade is completed.	5.5.3.4.2 (38)	D
	AGF Functional Device SDH Interface Requirements	**5.5.3.4.3**	
39	The STM-1/STM-1c optical interface shall conform to optical parameters for application code I-1 per ITU–T Recommendation G.957, Table 2.	5.5.3.4.3 (1)	R
40	The STM-1/STM-1c optical interface shall conform to optical parameters for application code S-1.1 per ITU–T Recommendation G.957, Table 2.	5.5.3.4.3 (2	R
41	The STM-1/STM-1c optical interface shall conform to optical parameters for application code S-1.2 per ITU–T Recommendation G.957, Table 2.	5.5.3.4.3 (3)	R
42	The STM-1/STM-1c optical interface shall conform to optical parameters for application code L-1.1 per ITU–T Recommendation G.957, Table 2.	5.5.3.4.3 (4)	R
43	The STM-1/STM-1c optical interface shall conform to optical parameters for application code L-1.2 per ITU–T Recommendation G.957, Table 2.	5.5.3.4.3 (5)	R
44	The STM-1/STM-1c optical interface shall conform to optical parameters for application code L-1.3 per ITU–T Recommendation G.957, Table 2.	5.5.3.4.3 (6)	R
45	The STM-1 interfaces shall be capable of having an MMF interface option for both transmit and receive using MMF as described in ITU-T Recommendation G.651.	5.5.3.4.3 (7)	O/D
46	The STM-1/STM-1c interfaces shall be capable of using SMF as described in ITU-T Recommendation G.652.	5.5.3.4.3 (8)	R
47	The STM-4/STM-4c optical interface shall conform to optical parameters for application code I-4 per ITU–T Recommendation G.957, Table 3.	5.5.3.4.3 (9)	R
48	The STM-4/STM-4c optical interface shall conform to optical parameters for application code S-4.1 per ITU–T Recommendation G.957, Table 3.	5.5.3.4.3 (10)	R
49	The STM-4/STM-4c optical interface shall conform to optical parameters for application code S-4.2 per ITU–T Recommendation G.957, Table 3.	5.5.3.4.3 (11)	R
50	The STM-4/STM-4c optical interface shall conform to optical parameters for application code L-4.1 per ITU–T Recommendation G.957, Table 3.	5.5.3.4.3 (12)	R
51	The STM-4/STM-4c optical interface shall conform to optical parameters for application code L-4.2 per ITU–T Recommendation G.957, Table 3.	5.5.3.4.3 (13)	R
52	The STM-4/STM-4c optical interface shall conform to optical parameters for application code L-4.3 per ITU–T Recommendation G.957, Table 3.	5.5.3.4.3 (14)	R
53	The STM-4/STM-4c interfaces shall be capable of having an MMF interface option for both transmit and receive using MMF as described in ITU-T Recommendation G.651.	5.5.3.4.3 (15)	D
54	The STM-4/STM-4c interfaces shall be capable of using SMF as described in ITU-T Recommendation G.652.	5.5.3.4.3 (16)	R
55	The STM-16/STM-16c optical interface shall conform to optical parameters for application code I-16 per ITU-T Recommendation G.957, Table 4.	5.5.3.4.3 (17)	R
56	The STM-16/STM-16c optical interface shall conform to optical parameters for application code S-16.1 per ITU-T Recommendation G.957, Table 4.	5.5.3.4.3 (18)	R
57	The STM-16/STM-16c optical interface shall conform to optical parameters for application code S-16.2 per ITU-T Recommendation G.957, Table 4.	5.5.3.4.3 (19)	R
58	The STM-16/STM-16c optical interface shall conform to optical parameters for application code L-16.1 per ITU-T Recommendation G.957, Table 4.	5.5.3.4.3 (20)	R
59	The STM-16/STM-16c optical interface shall conform to optical parameters for application code L-16.2 per ITU-T Recommendation G.957, Table 4.	5.5.3.4.3 (21)	R
60	The STM-16/STM-16c optical interface shall conform to optical parameters for application code L-16.3 per ITU-T Recommendation G.957, Table 4.	5.5.3.4.3 (22)	R

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

ID	Requirement	UCR Ref (UCR 2008 CH1)	Required (R)/ Conditional (C)
61	Software programmable SFP that supports STM-1/STM-4 and STM-1c/STM-4c Optical interface shall conform to optical parameters for application Code L-16.2 per ITU-T Recommendation G.957, Table 4.	5.5.3.4.3 (23)	D
62	Programmable SFP that supports STM-1/STM-4 optical interfaces shall be capable of having an MMF interface option for both transmit and receive using MMF as described in ITU-T Recommendation G.651.	5.5.3.4.3 (24)	D
63	Software programmable SFP that supports STM-1/STM-4/STM-16 optical interface shall conform to optical parameters for application code L-16.2 per ITU-T Recommendation G.957, Table 4.	5.5.3.4.3 (25)	D
64	The STM-64 Optical interface shall conform to ITU-T Recommendation G.691 optical interfaces for Single-Channel STM-64 systems.	5.5.3.4.3 (26)	R
65	The STM-64 Optical interface shall conform to ITU-T Recommendation G.691.	5.5.3.4.3 (27)	D
66	The software has to provide options from the STM-1 through STM-16 optical interfaces and the upgrade capability to the next higher optical rate by changing cards unless the optics is software programmable. If the optics is software programmable, then this capability must be allowed by changing the software setting to the next higher rate. Both procedures must preserve the customer data provisioned on the optical interface and move to the equivalent bandwidth slot starting at the beginning STM. Example: STM-1 upgrade to STM-4, STM-4 to STM-16, and STM-16 to STM-64. Customer provisioned on STM-1 (VC3-1 through VC3-3) will occupy STM-1 VC3-1 through 3 on the STM-4 after the upgrade is completed.	5.5.3.4.3 (28)	R
67	The AGF functional device shall be able to provision, monitor, and detect faults, and restore optical services in a standardized and automated fashion.	5.5.3.4.3 (29)	R
	AGF Functional Device Lambda Interface Requirements	**5.5.3.4.3.1**	
68	The AGF functional device shall have Lambda interfaces at the 10 Gigabit rates. These shall be compatible with the transport requirements in Section 5.5.3.3, Transport Switch Function.	5.5.3.4.3.1 (1)	C
69	Lambda interfaces shall be compliant with the ITU-T Recommendation G.694.1 grid if an AGF functional device supports Lambda interfaces.	5.5.3.4.3.1 (2)	R
	AGF Functional Device Electrical Interface Requirements	**5.5.3.4.4**	
70	The AGF functional device shall support STS-1 (EC-1) electrical interfaces that comply with specifications and pulse masks as defined in Telcordia Technologies GR-253-CORE, Chapter 4.4 and ANSI T1.102.	5.5.3.4.4 (1)	C
71	The AGF functional device shall support DS1 electrical interfaces that comply with ANSI T1.102.	5.5.3.4.4 (2)	R
72	The AGF functional device shall support DS1 pseudowire transport via gateway SFPs	5.5.3.4.4 (3)	D
73	The AGF functional device shall support channelized and unchannelized DS1 Superframe (SF) format and Extended Superframe (ESF) format as specified in ANSI T1.403. The ability to read or write the ESF data link is required. The selection of format for any particular DS1 interface shall be user-selectable.	5.5.3.4.4 (4)	R
74	The AGF functional device shall support Alternate Mark Inversion (AMI) and Bipolar with Eight-Zero Substitution (B8ZS) line coding formats and unframed, D4, SF, and ESF framing format as specified in ANSI T1.403. The selection of framing format for any particular DS1 interface shall be user-selectable.	5.5.3.4.4 (5)	R
75	The AGF functional device shall support both in-band and out-band Facility Data Link (FDL) loop-up and loop-down codes as specified in ANSI T1.403.	5.5.3.4.4 (6)	R
76	The AGF functional device shall support FDL status messages and respond as specified in ANSI T1.403.	5.5.3.4.4 (7)	R
77	The AGF functional device shall support unframed DS1 electrical signals.	5.5.3.4.4 (8)	R
78	The electrical interface shall comply with ITU-T Recommendation G.703.	5.5.3.4.4 (9)	R
79	The AGF functional device shall support DS1 bit rate of 1.544 Mbps +/- 32 ppm as specified in ANSI T1.101.	5.5.3.4.4 (10)	R
80	The AGF functional device shall support DS1 100 ohms cable with maximum length of 655 feet as specified in ITU-T Recommendation G.703.	5.5.3.4.4 (11)	R

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

ID	Requirement	UCR Ref (UCR 2008 CH1)	Required (R)/ Conditional (C)
81	The AGF functional device shall support E1 electrical interfaces shall comply with ITU-T Recommendation G.711.	5.5.3.4.4 (12)	R
82	The AGF functional device shall support both channelized and unchannelized E1 as specified in ITU-T Recommendation G.711.	5.5.3.4.4 (13)	R
83	The E1 electrical interface format shall support both 30 and 31 channels when channelized with and without Cyclical Redundancy Check (CRC) as specified in ITU-T Recommendation G.711. The selection of format for any particular E1 interface shall be user-selectable.	5.5.3.4.4 (14)	R
84	The AGF functional device shall support E1 bit rate of 2.048 Mbps +/- 50 ppm as specified in ITU-T Recommendation G.703 and G.704.	5.5.3.4.4 (15)	R
85	The AGF functional device shall support DS3 electrical tributary interfaces that comply with ANSI T1.102-1993.	5.5.3.4.4 (16)	R
86	The AGF functional device DS3 interface shall support DS3 pulse shape that meets both ITU-T Recommendation G.703 and Telcordia Technologies GR-499-CORE.	5.5.3.4.4 (17)	R
87	The AGF functional device shall support channelized and unchannelized DS3 signals in either unframed, M13, or C-bit parity formats per ANSI T1.101 and T1.404. The selection of format for any particular DS3 interface shall be user-selectable.	5.5.3.4.4 (18)	R
88	The AGF functional device shall support DS3 C-bit far-end alarm and control signal to support alarm/status messages and loopback control on the DS3 and/or individual DS1 as specified in ANSI T1.101 and T1.404.	5.5.3.4.4 (19)	R
89	The AGF functional device shall support DS3 bit rate of 44.736 Mbps +/- 20 ppm as specified in ANSI T1.101.	5.5.3.4.4 (20)	R
90	The AGF functional device shall support E3 electrical tributary interfaces that comply with ITU-T Recommendation G.703.	5.5.3.4.4 (21)	R
91	The AGF functional device shall support channelized and unchannelized E3 signals using line coding of High Density Bipolar 3 Code (HDB-3).	5.5.3.4.4 (22)	R
92	The AGF functional device shall support E3 bit rate of 34.368 Mbps +/- 20 ppm as specified in ITU-T Recommendation G.703.	5.5.3.4.4 (23)	R
93	The AGF functional device shall be able to provision, monitor, and detect faults, and restore electrical (DS1, E1, DS3, E3) services in a standardized and automated fashion.	5.5.3.4.4 (24)	R
94	**AGF Functional Device Ethernet Interface Requirements**	**5.5.3.4.5**	
95	The AGF functional device shall provide interfaces for Ethernet, FE, and GbE services in conformance with IEEE 802.3 for Ethernet LAN interfaces.	5.5.3.4.5 (1)	R
96	The AGF functional device shall provide interfaces for 10GbE Services in conformance with IEEE 802.3 for Ethernet LAN/WAN interfaces.	5.5.3.4.5 (2)	D
97	The Logical Link IWF shall terminate the MAC layer of Ethernet as described in Ethernet Standard IEEE 802.3.	5.5.3.4.5 (3)	R
98	Ethernet interfaces shall accommodate Ethernet packets greater than 4470 bytes.	5.5.3.4.5 (4)	R
99	Ethernet services shall support port-based and flow-based VLANS for multiple rates and customer interfaces as per IEEE 802.1Q.	5.5.3.4.5 (5)	R
100	The AGF functional device shall support transparent VLAN tagging for Ethernet on SONET/SDH service.	5.5.3.4.5 (6)	R
101	The AGF functional device shall not, by default, perform any Layer 3 IP routing.	5.5.3.4.5 (7)	R
102	The AGF functional device shall be able to provision, monitor, and detect faults, and restore Ethernet services in a standardized and automated fashion.	5.5.3.4.5 (8)	R
103	The AGF functional device shall selectively provide QoS/CoS for Ethernet services according to IEEE 802.1Q.	5.5.3.4.5 (9)	R
104	Available Ethernet services shall include RPR (IEEE 802.17b), Generic Framing Procedure (GFP) (ITU-T Recommendation G.7041/Y.1303), Hardware Link Capacity Adjustment Scheme (LCAS), and Virtual Concatenation (VCAT).	5.5.3.4.5 (10)	D
105	Ethernet and FE Services on SONET shall support GFP (ITU-T Recommendation G.7041/Y.1303), hardware LCAS, low order VCAT (VT1.5), high order (STS-1) VCAT, and CCAT; STS-1 and STS-3c.	5.5.3.4.5 (11)	R

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

ID	Requirement	UCR Ref (UCR 2008 CH1)	Required (R)/ Conditional (C)
106	10GbE services on SONET shall support GFP (ITU-T Recommendation G.7041/Y.1303), hardware LCAS, high order (STS-1 or STS-3c) VCAT, and CCAT; STS-1, STS-3c, STS-12c, STS-48c, and STS-192c.	5.5.3.4.5 (12)	D
107	Ethernet and FE services on SDH shall support GFP (ITU-T Recommendation G.7041/Y.1303), hardware LCAS, low order VCAT (VC-12 and VC-3, and CCAT; VC-3 and VC-4.	5.5.3.4.5 (13)	R
108	Gigabit Ethernet services on SDH shall support GFP (ITU-T Recommendation G.7041/Y.1303), hardware LCAS, low order VCAT (VC-3), high order (VC-4) VCAT, and CCAT; VC-3, VC-4, VC-4-3, and VC-4-16.	5.5.3.4.5 (14)	R
109	Ten GbE services on SDH shall support GFP (ITU-T Recommendation G.7041/Y.1303), hardware LCAS, high order (VC-4) VCAT, and CCAT; VC-3, VC-4, VC-4-3, and VC-4-16, and VC-4-64.	5.5.3.4.5 (15)	D
110	The AGF functional device shall selectively provide point-to-point Ethernet services with dedicated non-shared bandwidth without queuing or buffering Ethernet frames.	5.5.3.4.5 (16)	R
111	Gigabit Ethernet and 10GbE interfaces shall be auto-sensing/auto-detecting and auto-configuring between incoming GbE and 10GbE signals.	5.5.3.4.5 (17)	R
112	Ethernet and FE interfaces shall be auto-sensing/auto-detecting and auto-configuring between incoming Ethernet and FE signals.	5.5.3.4.5 (18)	R
	AGF Functional Device Storage Area Network Interface Requirements	**5.5.3.4.6**	
113	The AGF functional device shall provide Fiber Connectivity (FICON) tributary interfaces and services as per ANSI X3.230.	5.5.3.4.6 (1)	D
114	The AGF functional device shall provide Enterprise Services Connectivity (ESCON) tributary interfaces and services as per ANSI X3.296.	5.5.3.4.6 (2)	D
115	**AGF Functional Device Cross-Connect Requirements**	**5.5.3.4.7**	
116	The AGF functional device shall cross connect with the granularity of STS-1 and VT1.5 on a SONET AGF functional device.	5.5.3.4.7 (1)	R
117	The STS-1 (high order) cross-connect fabric shall be capable of supporting at least 320 G of cross connects at the STS-1/STM-0 level.	5.5.3.4.7 (2)	R
118	The VT1.5 (low order) cross-connect fabric shall be scalable and capable of supporting at least 10 G of traffic at the VC-11/VC-12 level.	5.5.3.4.7 (3)	R
119	The AGF functional device shall have an Ethernet switch fabrics separate from its STS-1 or VT1.5 TDM fabric.	5.5.3.4.7 (4)	D
120	The IP Ethernet switch fabrics shall be scalable and capable of supporting at least 20 G of IP traffic.	5.5.3.4.7 (5)	R
121	The AGF functional device shall cross connect with the granularity of VC-12, VC-3, and VC-4 on a SDH AGF functional device (not necessarily simultaneously with STS-1 and VT1.5).	5.5.3.4.7 (6)	R
122	The AGF functional device shall perform Time Slot Interchange (TSI) and Time Slot Assignment (TSA) cross connect between DS1 interfaces and channelized DS3 interfaces into a SONET VT1.5 formatted within the STS containers.	5.5.3.4.7 (7)	R
123	The AGF functional device shall support structured Administrative Unit-4 (AU-4) mapping for SDH applications using the ITU multiplexing structure in ITU-T Recommendation G.707.	5.5.3.4.7 (8)	R
124	The AGF functional device shall be able to map T1, E1, T3, and E3 signals into an AU-4 mapping structure as per ITU-T G.707.	5.5.3.4.7 (9)	R
125	The AGF functional device shall support VC-11, VC-12, VC-3, and VC-4 cross-connect capability for SDH AU-4-based system.	5.5.3.4.7 (10)	R
126	The AGF functional device shall support SDH/SONET container gateway functionalities (i.e., VC-3 to STS-1 and VC-11 to VT1.5).	5.5.3.4.7 (11)	R
127	The AGF functional device shall have the ability to retime signals from either VT1.5 or DS1 formats, as well as pass timing through the matrix directly to provide timing up to Stratum 1 via DS1 ports.	5.5.3.4.7 (12)	D
128	The AGF functional device cross-connects and interfaces shall be compatible with network-side STS or Lambda cross-connects at the DISN switch or the DISN Transport Element.	5.5.3.4.7 (13)	R
129	The AGF functional device cross-connects and interfaces at the AGF functional device shall be transparent to all protection switching at the DISN switch or the DISN Transport Element.	5.5.3.4.7 (14)	R

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

ID	Requirement	UCR Ref (UCR 2008 CH1)	Required (R)/ Conditional (C)
130	The AGF functional device shall support SONET provisioning of CCAT formats; OC-3c, OC-12c, OC-48c, and OC-192c.	5.5.3.4.7 (15)	R
131	The AGF functional device shall support SONET provisioning of OC-768c CCAT formats.	5.5.3.4.7 (16)	D
132	The AGF functional device shall support SDH provisioning of CCAT formats; VC-4-3c, VC-4-16c, and VC-4-64c.	5.5.3.4.7 (17)	R
133	The AGF functional device shall support SDH provisioning of VC-4-256c CCAT formats.	5.5.3.4.7 (18)	D
	AGF Functional Device Interface Performance Requirements	**5.5.3.4.8**	
134	The AGF functional device shall meet the jitter criteria for SONET systems in Telcordia Technologies GR-253-CORE, Section 5.6.	5.5.3.4.8 (1)	R
135	The AGF functional device shall meet the jitter criteria for SDH systems according to ITU-T Recommendation G.825 and ITU-T G.732.	5.5.3.4.8 (2)	R
136	The AGF functional device shall meet the interface jitter criteria specified for UNI interfaces for ITU-T OTN.	5.5.3.4.8 (3)	R
137	The jitter tolerance measured at the OC-N interface on the AGF functional device shall meet Figure A.1 input jitter tolerance specification documented in ANSI T1.105.03.	5.5.3.4.8 (4)	R
138	The jitter tolerance measured at the DS3 interface on the AGF functional device shall be at least 5 Unit Interval peak-to-peak (UIpp) between 10 Hertz (Hz) and 2.3 x 103 Hz, and at least 0.1 UIpp between 60 x 103 and 200 x 103 Hz as per Figure 7-1 in GR-499.	5.5.3.4.8 (5)	R
139	The jitter transfer measured between an input DS3 interface and the corresponding output DS3 interface on an AGF functional device (with its OC-12 or OC-3 signal looped-back) shall be less than the jitter transfer mask shown in Figure 7-4 of GR-499.	5.5.3.4.8 (6)	R
140	The jitter generation measured at the OC-N interface on the AGF functional device shall be less than 0.01 UIrms, when measured using a high-pass filter with 12-kHz cut-off frequency per ANSI T1.105.03, Section A.3.3.	5.5.3.4.8 (7)	R
141	The jitter generation due to DS3/STS-1 payload mapping for the DS3 interface on the AGF functional device shall be less than 0.4 UIpp, without pointer adjustments as per ANSI T1.105.03, Section 6.1.2.1.	5.5.3.4.8 (8)	R
142	The jitter generation due to DS3/STS-1 payload mapping for the DS3 interface on the AGF functional device shall be less than A1 equals A0 plus .3 UIpp for a single pointer adjustment as shown in Table 2 of ANSI T1.105.03-1994.	5.5.3.4.8 (9)	R
143	The jitter generation due to DS3/STS-1 payload mapping for the DS3 interface on the AGF functional device shall be less than 1.3 UIpp for pointer adjustment bursts as shown in Table 3 of ANSI T1.105.03.	5.5.3.4.8 (10)	R
144	The jitter generation due to DS3/STS-1 payload mapping for the DS3 interface on the AGF functional device shall be less than 1.2 UIpp for phase transient pointer adjustment bursts as shown in Table 4 of ANSI T1.105.03.	5.5.3.4.8 (11)	R
145	The jitter generation due to DS3/STS-1 payload mapping for the DS3 interface on the AGF functional device shall be less than 1.3 UIpp for periodic pointer adjustments as shown in Table 6 of ANSI T1.105.03-1994.	5.5.3.4.8 (12)	R
146	The jitter generation due to DS3/STS-1 payload mapping for the DS3 interface on the AGF functional device shall be less than 5 UIpp between 10 Hz and 500 Hz, and at least 0.1 UIpp between 8x10 3 and 40x10 3 Hz per Figure 7-1 of Telcordia Technologies GR-499-CORE.	5.5.3.4.8 (13)	R
147	The jitter transfer measured between an input DS1 interface and the corresponding output DS1 interface on the AGF functional device (with its OC-12 or OC-3 signal looped back) shall be less than the jitter transfer mask shown in Figure 7-4 of Telcordia Technologies GR-499-CORE.	5.5.3.4.8 (14)	R
148	The jitter generation due to DS1/VT-1.5 payload mapping without pointer adjustments for the DS1 interface on the AGF functional device shall be less than 0.7 UIpp per ANSI T1.105.03s, Section 6.1.1.1.	5.5.3.4.8 (15)	R

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

ID	Requirement	UCR Ref (UCR 2008 CH1)	Required (R)/ Conditional (C)
149	The jitter generation due to DS1/VT1.5 payload mapping and a single pointer adjustment for the DS1 interface on the AGF functional device shall meet the single VT pointer adjustment Maximum Time Interval Error (MTIE) mask shown on Figure 8 of the ANSI T1X1.3/94-001R5 supplement to ANSI T1.105.03.	5.5.3.4.8 (16)	R
150	The jitter generation due to DS1/VT1.5 payload mapping and periodic pointer adjustments for the DS1 interface on the AGF functional device shall meet the periodic VT pointer adjustment MTIE mask shown on Figure 10 of the ANSI T1X1.3/94-001R5 supplement to ANSI T1.105.03.	5.5.3.4.8 (17)	R
151	The maximum delay for a full STS passed through the AGF functional device (OC-N to OC-N), or for an STS add/drop shall not exceed 25 microseconds (µs) as per Telcordia Technologies TR-496, (R) [3-45].	5.5.3.4.8 (18)	R
152	The maximum delay for a floating VT passed through a DISN Access element (OC-N to OC-N), or for a floating VT add/drop (OC-N to low-speed or low-speed to OC-N) shall not exceed 50 microseconds (µs) as per Telcordia Technologies, TR-496, (R) [3-46].	5.5.3.4.8 (19)	R
	AGF Functional Device Equipment Redundancy Requirements	**5.5.3.4.9**	
153	No single failure in the switch fabric shall affect service. The AGF functional device shall meet Telcordia Technologies GR-2996-CORE requirements for fabric availability.	5.5.3.4.9 (1)	R
154	The interface cards shall be capable of switching between the working and protection switch fabric in an errorless manner for manual operation, and in a hitless manner for automated operation. No bits shall be lost or corrupted with errorless switching. Bit errors are allowed with hitless switching. However, hitless switching shall not cause downstream reframing to occur.	5.5.3.4.9 (2)	R
155	A PDH (DS1, DS3, E1, E3) card shall support a 1:1 configuration.	5.5.3.4.9 (3)	R
156	A PDH (DS1, DS3, E1, E3) card should support a 1:N configuration.	5.5.3.4.9 (4)	D
157	The AGF functional device shall support redundant processor and cross-connect matrix working in an active/standby mode.	5.5.3.4.9 (5)	R
158	The AGF functional device shall support redundant power supply and electrical feeds.	5.5.3.4.9 (6)	R
	AGF Functional Device General Protection Requirements	**5.5.3.4.10**	
159	It shall be possible to provision any SONET port for 1+1 APS, 1:N APS; 1:N OP, 2-Fiber UPSR per Telcordia Technologies GR-1400-CORE, or 2/4-Fiber BLSR per Telcordia Technologies GR-1230-CORE.	5.5.3.4.10 (1)	R
160	It shall be possible to provision any SDH port for 1+1 APS, 0:1 APS, 1:N APS, 1+1 2/4-Fiber Unidirectional Ring, or 2-Fiber MS Shared Protection Ring per ITU-T Recommendation G.841.	5.5.3.4.10 (2)	R
161	When the AGF functional device participates in point-to-point UPSR or BLSR protection, switching shall take place in 50 ms. These protection mechanisms shall be definable and selectable from the EMS, and shall offer the selection of revertive and non-revertive restoration mechanisms.	5.5.3.4.10 (3)	R
162	When the AGF functional device participates in point-to-point UPSR or BLSR protection and the selection of revertive restoration mechanisms shall have a revertive timer that is software programmable in a 30-second increment from 0 to 5 minutes, at a minimum.	5.5.3.4.10 (4)	R
163	The service restoration for a protection switch shall be automatic and accomplished without human or central management system intervention.	5.5.3.4.10 (5)	R
164	The protection switching mechanism shall be independent among separately managed network domains. A protection switch in one separately managed network domain shall not propagate or relay to another separately managed network domain.	5.5.3.4.10 (6)	R
165	The maximum detection time to determine if a signal's BER threshold is exceeded shall comply with Telcordia Technologies GR-253-CORE and ITU-T Recommendation G.783.	5.5.3.4.10 (7)	R
166	Once a decision is made to switch, the terminal circuit pack switching shall take place within 50 ms, as described in Telcordia Technologies GR-253-GORE and ITU-T Recommendation G.783.	5.5.3.4.10 (8)	C

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

ID	Requirement	UCR Ref (UCR 2008 CH1)	Required (R)/ Conditional (C)
167	Catastrophic failures on a user-definable Excessive BER (EBER) condition shall be detected by an equipment-protected circuit pack in a terminal within 10 ms as described in Telcordia Technologies GR-253-GORE and ITU-T Recommendation G.783.	5.5.3.4.10 (9)	R
168	When equipped, the AGF functional device shall be compliant with types and characteristics of SDH network protection architectures as defined in ITU-T G.841.	5.5.3.4.10 (10)	R
169	When equipped, the AGF functional device shall be compliant with interworking of SDH network protection architectures as defined in ITU-T Recommendation G.842.	5.5.3.4.10 (11)	R
	AGF Functional Device Interoperability Requirements	**5.5.3.4.11**	
170	The AGF functional device user interfaces, software, firmware, and hardware shall be fully compatible and interoperable with and without protection mechanisms of the OTS muxponder, OTS ROADM, ODXC, M13, STI, DSN MFS, encryption devices, and DISN Provider (P), Provider Edge (PE), Aggregation Routers (ARs).	5.5.3.4.11 (1)	R
171	The AGF functional device cross-connects and interfaces shall be compatible with network-side STS, STM, or Lambda cross-connects at the OTS muxponder, OTS ROADM, and ODXC.	5.5.3.4.11 (2)	R
172	The AGF functional device cross-connects and interfaces at the AGF functional device shall be compatible with all protection switching at OTS muxponder, OTS ROADM, ODXC, M13, STI, DSN MFS, encryption devices, and DISN P, PE, ARs.	5.5.3.4.11 (3)	R
	AGF Functional Device Fault Management Requirements	**5.5.3.4.12**	
173	The AGF functional device shall send the appropriate AIS and RDI to adjacent systems, the EMS, and/or the higher level management system after detecting signal failure or degraded conditions for a specified alarm or indication activation time, as described in ANSI T1.231, Tables 2, 6, and 11.	5.5.3.4.12 (1)	R
174	The AGF functional device shall remove the appropriate AIS and RDI after the source system has cleared the signal failure or degraded condition for a specified alarm or indication activation time, as described in ANSI T1.231, Tables 2, 6, and 11.	5.5.3.4.12 (2)	R
175	Alarms shall indicate circuit-level or signal alarms, as well as alarms in the AGF functional device itself, such as Span Failure, LOS, Path Switch Complete/Fail, Laser Degradation, Card Failure, and Card Mismatch.	5.5.3.4.12 (3)	R
176	Standard SONET alarms shall be supported by the system, including LOS, LOP, LOF, Rx AIS, RDI, and RFI.	5.5.3.4.12 (4)	R
177	The AGF functional device shall indicate SONET timing synchronization failures. The AGF functional device shall give an alarm showing the inability to establish a PLL. The AGF functional device shall have the ability to monitor the BITS incoming references (BITS-A and BITS-B). The AGF functional device shall give an alarm when there is any timing change, e.g., a switch from BITS-A to BITS-B.	5.5.3.4.12 (5)	R
178	Each NE shall detect, report, and clear the following signal failure events or conditions: LOS, LOF, LOP, SEF, AIS, and OOF, according to ANSI T1.231.	5.5.3.4.12 (6)	R
179	The AGF functional device shall provide the following DS3 alarms and report them to the EMS: LOS and AIS (or blue alarm). Definitions are the same as with DS1. The AGF functional device shall be able to transmit and receive the Far-End Out Of Frame (FEOOF) alarm for those AGF functional devices that transmit them. In addition, the AGF functional device shall be able to transmit and receive Far-End Alarm and Control (FEAC) signals. The FEAC option allows the AGF functional device to display far-end alarm and status information via the FEAC channel and to transmit FEAC messages from the near end to the far end.	5.5.3.4.12 (7)	R
180	The AGF functional device shall provide the following SONET VT alarms and report them to the EMS: include signal label mismatch, receive unequipped, and Rx AIS. Signal label mismatch tells whether the VT payload is locked or floating. Receive unequipped indicates that the far-end SONET port has not been provisioned.	5.5.3.4.12 (8)	R

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

ID	Requirement	UCR Ref (UCR 2008 CH1)	Required (R)/ Conditional (C)
181	The AGF functional device shall provide the following DS1 alarms and report them to the EMS: AIS or yellow alarm, LOS, Remote Alarm Indication (RAI)/yellow alarm, and excess zeroes. Alarm Indication Signal is transmitted as a result of a received LOS. The RAI or yellow alarm is transmitted upstream to indicate a red alarm or LOS downstream. Alarms shall indicate which physical port is receiving or transmitting the alarm. The yellow or RAI alarm is for ESF circuits only. Excess zeroes alarm only applies to D4/Superframe circuits.	5.5.3.4.12 (9)	R
182	The AGF functional device shall have LEDs for minor, major, and critical alarms and the LED must be set and cleared when a alarm of the defined category is present or cleared as defined by Telcordia Technologies GR.253-CORE.	5.5.3.4.12 (10)	R
183	The AGF functional device shall provide alarm status with at least the following minimum information: reference number, date and time of occurrence, node name, card type/slot, severity (i.e., minor, major, critical, informational), and alarm status (set, clear, transient).	5.5.3.4.12 (11)	R
	AGF Functional Device Performance Monitoring Requirements	**5.5.3.4.13**	
184	The AGF functional device shall provide a performance monitoring capability of all the supported interfaces (i.e., PDH, SONET, SDH) in accordance with Telcordia Technologies GR-253-CORE, and ITU-T Recommendation G.829.	5.5.3.4.13 (1)	R
185	The PDH performance monitoring shall provide ES, Severally SES, Unavailable Seconds, BP or CV, LOS, and AIS in accordance with Telcordia Technologies GR-820-CORE and ITU-T Recommendations G.826.	5.5.3.4.13 (2)	R
186	The SONET performance monitoring shall provide ES, SES, unavailable seconds, CV, LOS, AIS, and pointer adjustments in accordance with Telcordia Technologies GR-499-CORE.	5.5.3.4.13 (3)	R
187	The SDH performance monitoring shall provide ES, SES, unavailable seconds, CV, LOS, AIS, and pointer adjustments in accordance with ITU-T G.829.	5.5.3.4.13 (4)	R
188	The Ethernet performance monitoring shall provide Link availability time, various pack sizes, undersize packets, jumbo frames, frame alignment errors, frame check sequence errors, fragmentation, and CRC alignment errors in accordance with IEEE 802.3.	5.5.3.4.13 (5)	R
189	The optical card performance monitoring shall provide receive power, transmit power, bias current, low power threshold, and high power threshold in accordance with Telcordia Technologies GR-253-CORE.	5.5.3.4.13 (6)	R
190	All interfaces shall provide alarm thresholds for error rates that are determine to be degraded (10E-6) and failed (10E-3) and declare alarms based on the error rates to the user via the alarm in accordance with Telcordia Technologies GR-253-CORE and ITU-T Recommendation G.829.	5.5.3.4.13 (7)	R
	AGF Functional Device Requirements	**5.5.3.4.14**	
191	The AGF functional device shall perform hair-pinning and ADM functions in accordance with Telcordia Technologies GR-496-CORE.	5.5.3.4.14 (1)	R
192	The AGF functional device shall perform drop ADM functions in accordance with Telcordia Technologies GR-496-CORE.	5.5.3.4.14 (2)	R
193	The AGF functional device shall perform continued ADM functions in accordance with Telcordia Technologies GR-496-CORE.	5.5.3.4.14 (3)	R
194	The AGF functional device shall perform drop and continue ADM functions in accordance with Telcordia Technologies GR-496-CORE.	5.5.3.4.14 (4)	D
195	The AGF functional device shall provide the ability to hub or nest lower DISN Access elements in a linear or ring configuration from user-side interfaces.	5.5.3.4.14 (5)	R
196	The AGF functional device shall not use external connections for ring interconnection. Where multiple rings can be supported by a single shelf, connectivity between rings shall be accomplished via the switch matrix. No external connection between tributary interfaces shall be used to cross connect rings in the same bay.	5.5.3.4.14 (6)	D
197	The AGF functional device shall be protocol-transparent to incoming bit streams. Except for internetworking functions associated with Ethernet services within the AGF functional device, the AGF functional device shall not perform any user protocol conversions.	5.5.3.4.14 (7)	R

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

ID	Requirement	UCR Ref (UCR 2008 CH1)	Required (R)/ Conditional (C)
198	The AGF functional device shall not impart any errors onto the connections during cross-connects, grooming, or multiplexing.	5.5.3.4.14 (8)	R
199	The AGF functional device shall perform hair-pinning cross-connects without affecting the line capacity rate of the AGF functional device.	5.5.3.4.14 (9)	R
200	The AGF functional device shall send the appropriate AIS and RDI to adjacent AGF functional devices, the EMS, and/or higher level management systems after detecting signal failure or degraded conditions for a specified alarm or indication activation time per ANSI T1.231, Tables 2, 6 and 11.	5.5.3.4.14 (10)	R
201	The AGF functional device shall remove appropriate AIS and RDI after another AGF functional device has cleared the signal failure or degraded conditions for a specified alarm or indication activation time per ANSI T1.231, Tables 2, 6, and 11.	5.5.3.4.14 (11)	R
202	The AGF functional device shall have internal local and remote terminal loopback capability per Telcordia Technologies GR-253-CORE, (R) 6-380.	5.5.3.4.14 (12)	D
203	The AGF functional device shall have a local and remote service loopback capability as per Telcordia Technologies GR-253-CORE, (R) 6-389.	5.5.3.4.14 (13)	R
204	The AGF functional device with DS1/E1 line terminations shall provide both DS1/E1 terminal and service loopback capabilities as per Telcordia Technologies GR-253-CORE, (O) 6-397.	5.5.3.4.14 (14)	R
205	The AGF functional device with DS3 line terminations shall provide both DS3 terminal and service loopback capabilities per Telcordia Technologies GR-253-CORE, (O) 6-397.	5.5.3.4.14 (15)	R
206	The AGF functional device should support BER Testing using standard test patterns: PRBS15, PRBS20, PRBS23, QRSS, and ATL1s0s.	5.5.3.4.14 (16)	D
	AGF Functional Device Interface Performance Requirements	**5.5.3.4.15**	
207	The AGF functional device shall meet the jitter criteria for SONET systems in Telcordia Technologies GR-253-CORE, Section 5.6.	5.5.3.4.15 (1)	R
208	The AGF functional device shall meet the jitter criteria for SDH systems according to ITU-T Recommendations G.825 and ITU-T Recommendations G.732.	5.5.3.4.15 (2)	R
209	The AGF functional device shall meet the interface jitter criteria specified for UNI interfaces for ITU-T OTNs.	5.5.3.4.15 (3)	R
210	The jitter tolerance measured at the OC-N interface on the AGF functional device shall meet Figure A.1 input jitter tolerance specification documented in ANSI T1.105.03.	5.5.3.4.15 (4)	R
211	The jitter tolerance measured at the DS3 interface on a DISN Access element shall be at least 5 UIpp between 10 Hz and 2.3 x 103 Hz, and at least 0.1 UIpp between 60 x 103 and 200 x 103 Hz per Figure 7-1 in TR-499.	5.5.3.4.15 (5)	R
	AGF Functional Device EMS Requirements	**5.5.3.4.16**	
212	The AGF functional device EMS shall report PHY (Layer 1) statistics. Further, it shall report Layer 2 errors. It shall report all QoS parameters defined for the RPR as described in IEEE 802.17.	5.5.3.4.16 (1)	R
213	The AGF functional device EMS shall be able to track frame errors, P-Bit parity errors, C-Bit parity errors, and FEBE.	5.5.3.4.16 (2)	R
214	The AGF functional device EMS shall be able to provision the AGF functional device on all interfaces (i.e., PDH/SONET/SDH/Ethernet) and be able to provision a circuit using the different types of cross-connects (VT1.5, VC-11, VC-12, VC-3, VC-4, STS-1, STM-1, STS-3c, STM-4, STS-12c, STM-16, STS-48c, STM-64, and STS-192c).	5.5.3.4.16 (3)	R
215	The AGF functional device EMS shall be able to build protection topologies APS 1+1, UPSR, and BLSR.	5.5.3.4.16 (4)	R
216	The AGF functional device EMS shall be able to provision card parameters required for interoperability to interconnecting carrier systems; and interface framing format, and line type, line build out.	5.5.3.4.16 (5)	R
217	The AGF functional device EMS shall be able to provision alarms profiles according to network requirements (i.e., minor, major, critical, none service affecting, and none reporting).	5.5.3.4.16 (6)	R
218	The AGF functional device EMS shall be able to review and retrieve alarm and administration logs.	5.5.3.4.16 (7)	R

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

ID	Requirement	UCR Ref (UCR 2008 CH1)	Required (R)/ Conditional (C)
219	The AGF functional device EMS shall be able to set the alarm threshold on any interface (i.e., SD and SF).	5.5.3.4.16 (8)	R
220	The AGF functional device EMS shall be able to provision all administrated and security screens based on password level (i.e., network IP address, NE name, user accounts, and radius server).	5.5.3.4.16 (9)	R
	Physical Design Requirements	**5.5.3.4.17**	
221	All TSF elements shall meet the EMC/EMI requirements defined in FCC Part 15 Class A.	5.5.3.4.17 (1)	R
222	All TSF elements shall meet the EMC/EMI requirements defined in Telcordia Technologies GR-1089-CORE.	5.5.3.4.17 (2)	R
223	Required] All TSF elements shall meet the EMC/EMI requirements defined in ETSI EN 50082.	5.5.3.4.17 (3)	R
224	All TSF elements shall meet the EMC/EMI requirements defined in ETSI EN 55022.	5.5.3.4.17 (4)	R
225	All TSF elements shall meet the EMC/EMI requirements defined in ETSI EN 300-386.	5.5.3.4.17 (5)	R
226	All TSF 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.	5.5.3.4.17 (6)	R
227	All TSF elements shall be designed to be fully 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.	5.5.3.4.17 (7)	R
228	All TSF elements shall be designed to operate continuously in the following environment range without degradation. Altitude: -100 to 15,000 ft AMSL.	5.5.3.4.17 (8)	R
229	All TSF elements shall be designed to be fully operational after transportation and/or storage in the following environment range: Transport Altitude: -100 ft to +40,000 ft AMSL.	5.5.3.4.17 (9)	R
230	All TSF 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.	5.5.3.4.17 (10)	R
231	All TSF elements shall be fully operational throughout the battery voltage range of -41.5 to -56 VDC.	5.5.3.4.17 (11)	R
232	All TSF elements shall not be damaged and shall recover to normal performance following application of the following maximum transient voltages for the durations given (nominal voltage 48 VDC): 75 VP-P for 1 msec, 60 VP-P for 500 msec.	5.5.3.4.17 (12)	R
233	All TSF elements shall be fully NEBS, Level 3 compliant.	5.5.3.4.17 (13)	R
234	All TSF 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.	5.5.3.4.17 (14)	R
235	All TSF elements shall be designed to be fully 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.	5.5.3.4.17 (15)	R
236	All TSF elements shall be designed to operate continuously in the following environment range without degradation. Altitude: -100 to 15,000 ft AMSL.	5.5.3.4.17 (16)	R
237	All TSF elements shall be designed to be fully operational after transportation and/or storage in the following environment range: Transport Altitude: -100 ft to +40,000 ft AMSL.	5.5.3.4.17 (17)	R
238	All TSF 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.	5.5.3.4.17 (18)	R
239	All TSF elements shall be fully operational throughout the battery voltage range of: -41.5 to -56 VDC.	5.5.3.4.17 (19)	R

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

ID	Requirement	UCR Ref (UCR 2008 CH1)	Required (R)/ Conditional (C)
240	All equipment shall have been tested and registered as compliant to the following electrical safety standards: UL-1950, EN60950, and IEC 60950.	5.5.3.4.17 (20)	R
	AGF Functional Device Standards Compliance Requirements	**5.5.3.4.18**	
241	ITU-T Recommendation G.651.1 (2007)	5.5.3.4.18 (1)	R
242	ITU-T Recommendation G.652 (10/2000) (Revised in 2005)	5.5.3.4.18 (2)	R
243	ITU-T Recommendation 694.1 (2002)	5.5.3.4.18 (3)	R
244	ITU-T Recommendation G.703 (2001)	5.5.3.4.18 (4)	R
245	ITU-T Recommendation G.707/Y.1322 (2007)	5.5.3.4.18 (5)	R
246	ITU-T Recommendation G.709/Y.1331	5.5.3.4.18 (6)	R
247	ITU-T Recommendation G.711 (1988)	5.5.3.4.18 (7)	R
248	ITU-T Recommendation G.732 (1988).	5.5.3.4.18 (8)	R
249	ITU-T Recommendation G.783 (2006)	5.5.3.4.18 (9)	R
250	ITU-T Recommendation G.825 (2000)	5.5.3.4.18 (10)	R
251	ITU-T Recommendation G.829	5.5.3.4.18 (11)	R
252	ITU-T Recommendation G.841 (1998)	5.5.3.4.18 (12)	R
253	ITU-T Recommendation G.842 (1997)	5.5.3.4.18 (13)	R
254	ITU-T Recommendation G.872 (2001)	5.5.3.4.18 (14)	R
255	ITU-T Recommendation G.957 (2006)	5.5.3.4.18 (15)	R
256	ITU-T Recommendation G.7041/Y-1303 (2003) (Revised in 2008)	5.5.3.4.18 (16)	R
257	ANSI T1.101	5.5.3.4.18 (17)	R
258	ANSI T1.102-1999	5.5.3.4.18 (18)	R
259	ANSI T1.105.1-2000	5.5.3.4.18 (19)	R
260	ANSI T1.105.03-1994 (Revised 2003 (R2008))	5.5.3.4.18 (20)	R
261	ANSI T1.105.06 – 2002 (R2007)	5.5.3.4.18 (21)	R
262	ANSI T1.107-2002 (R2006)	5.5.3.4.18 (22)	R
263	ANSI T1.231-1993 (Revised 2003 (R2007))	5.5.3.4.18 (23)	R
264	ANSI T1.403-1999 (R2007)	5.5.3.4.18 (24)	R
265	ANSI T1.404-2002 (R2006)	5.5.3.4.18 (25)	R
266	Telcordia Technologies GR-253-CORE, Issue 3, September 2000 (Issue 4, December 2005)	5.5.3.4.18 (26)	R
267	Telcordia Technologies GR-496-CORE, Issue 1, December 1998, (Issue 2, August 2007)	5.5.3.4.18 (27)	R
268	Telcordia Technologies GR-499-CORE, Issue 2, December 1998 (Issue 3, September 2004)	5.5.3.4.18 (28)	R
269	Telcordia Technologies GR-820-CORE, Issue 2, December 1997	5.5.3.4.18 (29)	R
270	IEEE 802.3-2008	5.5.3.4.18 (30)	R
271	IEEE 802.1Q-2003	5.5.3.4.18 (31)	R
272	IEEE 802.17-2004, IEEE standard for information technology-telecommunications and information exchange between systems-local and metropolitan area networks-specific requirements-part 17: resilient packet ring (RPR) access method and physical layer specifications	5.5.3.4.18 (32)	R
273	X3-230. ANSI FC-SB-3 and INCITS 230:1994 [R2004]	5.5.3.4.18 (33)	R
274	British Standards Institute BS EN 60950-1 August 6, 2006	5.5.3.4.18 (34)	R
275	IEC 60950-1, 2006	5.5.3.4.18 (35)	R
276	CFR FCC Part 15, Class A	5.5.3.4.18 (36)	R
277	Network Equipment - Building System (NEBS), Level 3	5.5.3.4.18 (37)	R
278	Underwriters Laboratories, Inc. UL-1950, First Edition 1989	5.5.3.4.18 (38)	R

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

LEGEND:

ADIMSS	Advanced DSN Integrated Management Support System
ADM	Add-Drop Multiplexer
AGF	Access Grooming Function
AIS	Alarm Indicator Signal
AMSL	Above Mean Sea Level
ANSI	American National Standards Institute
APS	Automatic Protection Switch
BER	Bit Error Rate
BITS	Building Integrated Timing Supply
BLSR	Bidirectional Line Switched Ring
CCAT	Continuous Concatenation
CE	Customer Edge
CFR	Code of Federal Regulations
CGA	Carrier Group Alarm
CoS	Class of Service
CRC	Cyclic Redundancy Check
D-NE	Deployed-Network Element
DAA	Designated Approving Authority
DC	Direct Current
DCN	Data Communications Network
DISN	Defense Information Systems Network
DISR	DoD Information technology Standards and Profile Registry
DoD	Department of Defense
DoDI	DoD Instruction
DS	Digital Signal
DSN	Defense Switched Network
DVX	Deployed Voice Exchange
DWDM	Dense Wavelength Division Multiplexing
E1	European 1 (2048 bps, 30-channel PCM)
E3	European 3 (4 streams 8448 kbps)
EC	European Community
EDC	Electronic Dispersion Compensation
EIA	Electronic Industries Alliance
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EMS	Element Management System
EOL	End of Life
ESD	Electrostatic Discharge
ESF	Extended Superframe
ETSI	European Telecommunications Standard Institute
FE	Fast Ethernet
FCC	Federal Communications Commission
FDM	frequency-division multiplexing
FEBE	Far-End Block Error
FIPS	Federal Information Processing Standard
F-NE	Fixed-Network Element
GIG-BE	Global Information Grid-Bandwidth Expansion
GbE	Gigabit Ethernet
GR	Generic Requirement
IAW	In Accordance With
ID	Identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IP	Internet Protocol
IR	Intermediate Reach
ISDN	Integrated Services Data Network
ITU	International Telecommunication Union
ITU-T	International Telecommunication Union-Telecommunication
IWF	Interworking Function
KHz	Kilo Hertz
LAN	Local Area Network
LED	Light–emitting Diode
LOF	Loss of Frame
LR	Long Reach
MAC	Media Access Control
MAN	Metropolitan Area Networks
Mbps	Megabits per second
MFS	Multifunction Switch
MLPP	Multi-Level Precedence and Preemption
MOS	Mean Opinion Score
ms	Millisecond
msec	millisecond
NE	Network Element
NEBS	Network Equipment-Building System
NSA	National Security Agency
OA	Optical Amplifier
OC	Optical Carrier
ODU	Optical Channel Data Unit
ODXC	Optical Digital Cross Connect
OLA	Optical Line Amplifier
OOF	Out of Frame
ORL	Optical Return Loss
OSP	Open Shortest Path
OTN	Optical Transport Network
OTS	Optical Transport System
OXC	Optical Cross Connect
PCM	Pulse Code Modulation
PDH	Plesiochronous Digital Hiearchy
PHY	Physical Layer
PLL	Phase Locked Loop
ppm	Parts Per Million
PRI	Primary rate Interface
QoS	Quality of Service
R	Required
RAI	Remote Alarm Indication
RDI	Remote Defect Indication
RFI	Remote Failure Indication
ROADM	Reconfigurable Optical Add/Drop Multiplexor
Rx	Receive
SCIP	Secure Communication Interoperability Protocol
SDH	Synchronous Digital Hierarchy
SEF	Severely Errored Frame
SFP	Small Form Pluggable
SONET	Synchronous Optical Transport Network
SR	Short Reach
STIG	Security Technical implementation Guide
STM	Synchronous Transport Module
STS	Synchronous Transport Signal
T1	Trunk 1 (1544 bps, 24-channel PCM)
T3	Trunk 3
TDM	Time Division Multiplexing
TSF	Transport Switch Function
TTL	Transistor-transistor logic
UCCO	Unified Capabilities Certification Office
UCR	Unified Capabilities Requirement
UHF	Ultra high frequency
UIpp	Unit Interval Peak-to-Peak
UIrms	Unit Interval Root Mean Square
UNI	User Network Interface
UPSR	Unidirectional Path Switched Ring
VC	Virtual Circuit
VHF	Very High Frequency
VLAN	Virtual Local Area Network
VT	Virtual Tributary
VVoIP	Voice and Video over Internet Protocol
WAN	Wide Area Network

(This page intentionally left blank.)