DEFENSE INFORMATION SYSTEMS AGENCY
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IN REPLY REFER TO: Joint Interoperability Test Command (JTE)

FEB 10 2012

MEMORANDUM FOR DISTRIBUTION

SUBJECT: Special Interoperability Test Certification of the Avtec Systems ioPLEX 1010 Fixed Network Element, software release 4.3.3

References: (a) Department of Defense Directive 4630.05, "Interoperability and Supportability of Information Technology (IT) and National Security Systems (NSS)," 5 May 2004
(b) Chairman, Joint Chiefs of Staff Instruction 6212.01E, "Interoperability and Supportability of Information Technology and National Security Systems," 15 December 2008
(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 Avtec Systems ioPLEX 1010 Fixed Network Element, software release 4.3.3, is hereinafter referred to as the System Under Test (SUT). The JITC certifies the Avtec Systems SUT for joint use in the Defense Information Systems Network as a Fixed Network Element (F-NE). The Avtec Systems SUT can be deployed to extend legacy data, video, and voice services in native format over Ethernet, Internet Protocol (IP), Multi Protocol Label Switching (MPLS), and Asynchronous Transfer Mode (ATM) Networks and Wide Area Networks. The Defense Information Systems Agency (DISA) adjudicated all open Test Discrepancy Reports (TDRs) to have a minor operational impact. The SUT is a layer-2 device that transports IP version 4 and IP version 6 traffic transparently. The certification status of the SUT will be verified during operational deployment. Any new discrepancies noted in the operational environment will be evaluated for impact on the existing certification. These discrepancies will be adjudicated to the satisfaction of the DISA via a vendor Plan of Action and Milestones (POA&M) that will address all new critical TDRs within 120 days of identification. The JITC conducted testing using Network Element requirements derived from the UCR, Reference (c), and Network Element test procedures, Reference (d). The 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 Letters of Compliance (LoC), and Information Assurance (IA) Certification Authority (CA) approval of the IA configuration. The JITC, Indian Head, Maryland, conducted Interoperability testing from August through October 2011 and completed review of the vendor's LoCs on August 2011. The DISA IA CA has reviewed the IA Assessment Report for the SUT, Reference

(e), and based on the findings in the report has provided a positive recommendation. The acquiring agency or site will be responsible for the DoD Information Assurance Certification and Accreditation Process (DIACAP) accreditation. The JITC published the IA findings in a separate report, Reference (e). The DISA IA CA granted accreditation of the SUT on 7 December 2011. 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 an F-NE. Tables 1 and 2 list the interfaces, CRs, FRs, and the component status of the SUT.

Table 1. SUT Interface Interoperability Status

Interface	Critical (See note 1.)	UCR Ref (UCR 2008 CH 2)	CR/FR ID	Status	Remarks
Ingress (LAN side)					
Analog	No	5.9.3.2.1	1, 2, and 4	NA	Not supported by the SUT.
Serial	No	5.9.2.3.2	1, 2, and 4	Certified	SUT met requirements for specified interfaces.
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	NA	Not supported by the SUT.
OC-X	No	5.9.2.3.8	1, 2, 3, and 4	Certified	SUT met requirements for OC-3 and OC-12 ATM interfaces. See note 3.
IP (Ethernet) 10/100/1000	No	5.9.2.3.9	1, 2, 4, and 7	Certified	SUT met requirements for specified interfaces.
Egress (WAN side)					
Serial	No	5.9.2.3.2	1, 2, 3, and 4	Certified	SUT met requirements for specified interfaces.
DS1	No	5.9.2.3.4	1, 2, 3, and 4	Certified	SUT met requirements for specified interfaces.
E1	No	5.9.2.3.6	1, 2, 3, and 4	NA	Not supported by the SUT.
DS3	No	5.9.2.3.6	1, 2, 3, and 4	NA	Not supported by the SUT.
OC-X	No	5.9.2.3.8	1, 2, 3, and 4	Certified	SUT met requirements for OC-3 and OC-12 ATM interfaces. See note 3.
IP (Ethernet) 10/100/1000	No	5.9.2.3.9	1, 2, 4, and 7	Certified	SUT met requirements for specified interfaces. SUT provides MPLS services.
DLoS	No	5.9.2.3.9	1, 2, 3, 4, and 5	NA	Not supported by the SUT.
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	

Table 1. SUT Interface Interoperability Status (continued)

NOTES:
1. UCR does not specify any minimum interfaces. The SUT must minimally provide one of the listed ingress and egress interfaces specified.
2. CR/FR requirements are contained in Table 2. CR/FR numbers represent a roll-up of UCR requirements.
3. SUT supports ATM standards only for its OC-X interfaces so JITC tested OC-3 and OC-12 interface for ATM standards only.

LEGEND:

100Base-X	100 Mbps Ethernet generic designation	IP	Internet Protocol
10Base-X	10 Mbps Ethernet generic designation	ISDN	Integrated Services Digital Network
ATM	Asynchronous Transfer Mode	LAN	Local Area Network
BRI	Basic Rate Interface	Mbps	Megabits per second
CR	Capability Requirement	NA	Not Applicable
DLoS	Direct Line of Sight	NM	Network Management
DS1	Digital System Level 1 (1.544 Mbps)	OC-X	Optical Carrier - X (OC-3, OC-12, etc.,)
DS3	Digital System Level 3 (44.736 Mbps)	OLT	Optical line Terminal
E1	European Interface Standard (2.048 Mbps)	SUT	System Under Test
FR	Functional Requirement	UCR	Unified Capabilities Requirements
Gbps	Gigabits per second	WAN	Wide Area Network

Table 2. SUT Capability Requirements and Functional Requirements Status

CR/FR ID	Capability/ Function	Applicability (See note 1.)	UCR Ref (UCR 2008 CH 2)	Status	Remarks
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	NA	Not supported by the SUT.
	Loop-Back Capability	Conditional	5.9.2.4.3	NA	Not supported by the SUT.
	Operational Configuration Restoral	Required	5.9.2.4.4	Met	
5	**DLoS**				
	DLoS Transport	Conditional	5.9.2.4.5	NA	Not supported by the SUT.

Table 2. SUT Capability Requirements and Functional Requirements Status (continued)

CR/FR ID	Capability/ Function	Applicability (See note 1.)	UCR Ref (UCR 2008 CH 2)	Status	Remarks
6	**D-NE Requirements**				
	D-NE General Requirements	Required (See note 2.)	5.9.3.1	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	D-NE TDM Requirements	Conditional	5.9.3.2	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	D-NE IP Requirements	Conditional	5.9.3.3	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	Encapsulated TDM Requirements	Conditional	5.9.3.4	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	Carrier Group Alarms	Required (See note 2.)	5.9.3.5	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	Long-Local Requirements	Conditional	5.9.3.6	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	Proprietary IP Trunk Requirements	Conditional	5.9.3.7	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	Secure Call Handling	Required (See note 2.)	5.9.3.8	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	Voice Packet Multiplexing	Conditional	5.9.3.9	Not Tested	Sponsor requested to test the SUT as a fixed NE.
7	**IPv6 Requirements**				
	Product Requirements	Required	5.3.5.4	Met	SUT is a layer-2 device and transports IPv4 and IPv6 traffic transparently.
8	**NM Requirements**				
	VVoIP NMS Interface Requirements	Required	5.3.2.4.4	Met	
	General Management Requirements	Required	5.3.2.17.2	Met	

NOTES:
1. Annotation of 'required' refers to high-level requirement category. Applicability of each sub-requirement is provided in Enclosure 3.
2. Only applies if SUT seeking certification as an D-NE.

LEGEND:

ADPCM	Adaptive Differential Pulse Code Modulation	IPv4	Internet Protocol version 4
CR	Capabilities Requirement	IPv6	Internet Protocol version 6
DLoS	Direct Line of Sight	NA	Not Applicable
D-NE	Deployed Network Element	NE	Network Element
FR	Functional Requirement	NM	Network Management
G.726	ITU-T speech codec for ADPCM (32 Kbps)	NMS	Network Management System
G.728	ITU-T speech codec for LD-CELP (16 Kbps)	SUT	System Under Test
G.729	ITU-T speech codec for CS-ACELP (8 Kbps)	TDM	Time Division Multiplexing
ID	Identification	UCR	Unified Capabilities Requirements
IP	Internet Protocol	VVoIP	Voice and Video over Internet Protocol

5. In accordance with the Program Manager's request, JITC did not develop a detailed test report. JITC distributes interoperability information via the JITC Electronic Report Distribution system, which uses Non-secure Internet Protocol Router Network (NIPRNet) e-mail. More comprehensive interoperability status information is available via the JITC System Tracking Program (STP), 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 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 Capability Certification Office website located at https://aplits.disa.mil.

JITC Memo, JTE, Special Interoperability Test Certification of the Avtec Systems ioPLEX 1010 Fixed Network Element, software release 4.3.3.

6. The JITC testing point of contact is Ms. Jackie Mastin, commercial (301) 744-5375, or DSN 354-5375. Her e-mail address is Jackie.Mastin@disa.mil. The JITC mailing address is 3341 Strauss Avenue, Suite 236, Indian Head, Maryland 20640-5149. The Unified Capabilities Certification Office tracking number for the SUT is 1029101.

FOR THE COMMANDER:

3 Enclosures a/s

BRADLEY A. CLARK
Chief
Battlespace Communications Portfolio

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ADDITIONAL REFERENCES

(c) Office of the Assistant Secretary of Defense Document, "Department of Defense Unified Capabilities Requirements 2008, Change-2," December 2010
(d) Joint Interoperability Test Command Document, "Unified Capabilities Test Plan," 4 February 2010
(e) Joint Interoperability Test Command, "Information Assurance (IA) Assessment of Avtec Systems ioPLEX 1010 Fixed Network Element, software release 4.3.3, (TN1029101)," 30 October 2011

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CERTIFICATION TESTING SUMMARY

1. SYSTEM TITLE. Avtec Systems ioPLEX 1010 Fixed Network Element, software release 4.3.3

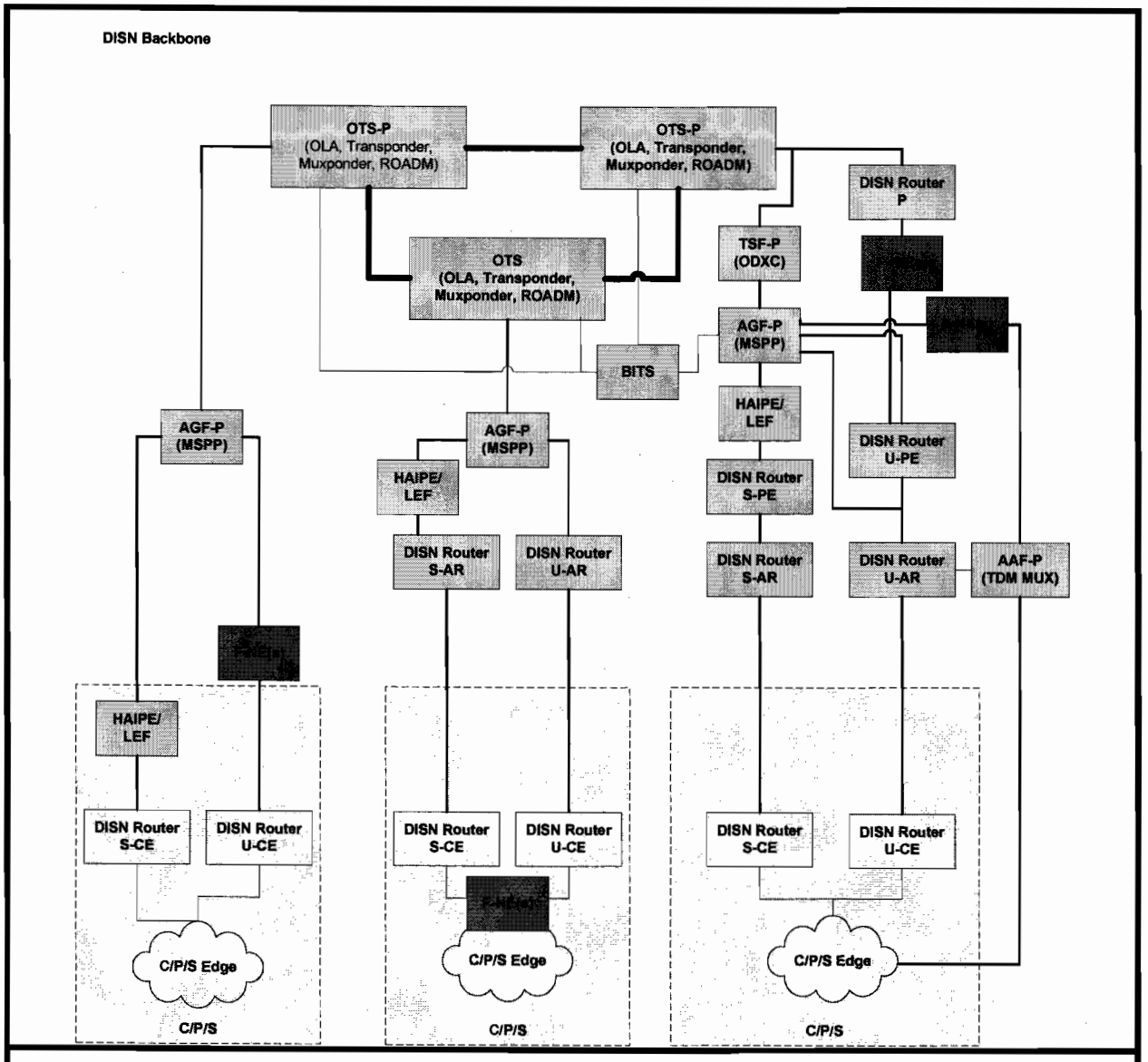
2. SPONSOR. Mr. Leon Nicely, PO Box 549, Fort Meade, MD; leon.nicely@disa.mil

3. SYSTEM POC. Hoang D. Vu, Avtec Systems, Inc. 14432 Albermarle Point Place, Chantilly, VA 20151, e-mail: hvu@avtec.com

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

5. SYSTEM DESCRIPTION. The Avtec Systems ioPLEX 1010 Fixed Network Element (F-NE) enables transparent delivery of critical command and telemetry data over cell/packet-switched networks (PSNs), in Asynchronous Transfer Mode (ATM) Networks and video, and voice services in native format over Ethernet, Internet Protocol (IP), Multi Protocol Label Switching (MPLS), Wide Area Network (WAN) and industry-standard pseudo-wire protocols as defined by the Internet Engineering Task Force, Psuedowire Working Group and Inter-range instrumentation Group (IRIG)-218-07. The gateway provides native interfaces for data (serial, analog, and bridged), voice (T1), and video (NTSC-SD) then packetizes the data for transmission through ATM circuits or pseudo-wire tunnels that enable Circuit Emulation Services (CES) across the WAN. The ioPLEX 1010 will add value to the Department of Defense (DoD) legacy data networks by providing the greater operational efficiency and a smooth migration strategy to a single converged network.

6. OPERATIONAL ARCHITECTURE. The JITC tested the Avtec Systems ioPLEX 1010 under the F-NE UCR product category. A high-level Defense Information Systems Network (DISN) node architecture, as depicted in Figure 2-1, displays the devices in the DISN architecture. The Avtec Systems ioPLEX 1010 F-NE solution can be deployed to extend DISN services and legacy data, video, and voice services in native format over Ethernet, IP, MPLS, and legacy ATM networks in the WAN and on a camp, post, or station within the Local Area Network (LAN) infrastructure. The Avtec Systems ioPLEX 1010 F-NE 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
AR	Aggregation Router
ATM	Asynchronous Transfer Mode
CE	Customer Edge Router
C-PE	Classified Provider Edge Router
C/P/S	Camp, Post, or Station
DISN	Defense Information System Network
F-NE	Fixed Network Element
HAIPE	High Assurance Internet Protocol Encryptor
MSPP	Multi-Service Provisioning Platform
MUX	Multiplexer
P	Provider Router
ODXC	Optical Digital Cross Connect
OLA	Optical Line Amplifier
OTS-P	Optical Transport System Product
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
T-PE	Transport Provider Edge Router
TSF-P	Transport Switch Function Product
U-AR	Unclassified Aggregation Router
U-CE	Unclassified Customer Edge Router
U-PE	Unclassified Provider Edge Router

Figure 2-1. DISN Architecture

7. INTEROPERABILITY REQUIREMENTS. The interface, Capability Requirements (CR), Functional Requirements (FR), Information Assurance (IA), and other requirements for NE products are established by Sections 5.4 and 5.9 of the Department of Defense Unified Capabilities UCR 2008, Change-2.

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

Table 2-1. NE Interface Requirements

Interface	Critical (See note 1.)	UCR Reference	Threshold CR/FR Requirements (See note 2.)	Criteria	Remarks
Ingress (LAN side)					
Analog	No	5.9.3.2.1	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. The SUT must minimally provide one of the listed ingress and egress interfaces specified.
2. CR/FR requirements are contained in Table 2. CR/FR numbers represent a roll-up of UCR requirements.

LEGEND:

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

7.2 Capability Requirements (CR) and Functional Requirements (FR). The NE products have required and conditional features and capabilities that are established by Section 5.9 of the UCR. The System Under Test (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 NE products. Table 3-1 of Enclosure 3 provides detailed CR/FR requirements.

Table 2-2. NE Capability Requirements and Functional Requirements

CR/FR ID	Capability/Function	Applicability (See note 1.)	UCR Ref (UCR 2008 CH 2)	Criteria	Remarks
1	**General NE Requirements**				
	General Requirements	Required	5.9.2.1	Meet applicable UCR requirements. Detailed requirements and associated criteria are provided in Table 3-1 of Enclosure 3.	Applies to both F-NE and D-NE.
	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.	Applies to both F-NE and D-NE.
	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.	Applies to both F-NE and D-NE.
	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.	Applies to both F-NE and D-NE.
6	**D-NE Requirements**				
	D-NE General Requirements	Required (See note 2.)	5.9.3.1	Meet applicable UCR requirements. Detailed requirements and associated criteria are provided in Table 3-1 of Enclosure 3.	Applies to D-NE.
	D-NE TDM Requirements	Conditional	5.9.3.2		
	D-NE IP Requirements	Conditional	5.9.3.3		
	Encapsulated TDM Requirements	Conditional	5.9.3.4		
	Carrier Group Alarms	Required (See note 2.)	5.9.3.5		
	Long-Local Requirements	Conditional	5.9.3.6		
	Proprietary IP Trunk Requirements	Conditional	5.9.3.7		
	Secure Call Handling	Required (See note 2.)	5.9.3.8		
	Voice Packet Multiplexing	Conditional	5.9.3.9		

Table 2-2. NE Capability Requirements and Functional Requirements (continued)

CR/FR ID	Capability/ Function	Applicability (See note 1.)	UCR Ref (UCR 2008 CH 2)	Criteria	Remarks
7	**IPv6 Requirements**				
	Product Requirements	Required	5.3.5.4	Meet UCR IPv6 requirements.	Applies to both F-NE and D-NE
8	**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.	Applies to both F-NE and D-NE.
	General Management Requirements	Required	5.3.2.17.2		

NOTES:
1. Annotation of 'required' refers to high-level requirement category. Applicability of each sub-requirement is provided in enclosure 3.
2. Only applies if SUT is seeking certification as an D-NE.

LEGEND:

ADPCM	Adaptive Differential Pulse Code Modulation	ID	Identification
CR	Capabilities Requirement	IP	Internet Protocol
DLoS	Direct Line of Sight	IPv6	Internet Protocol version 6
D-NE	Deployed Network Element	NE	Network Element
F-NE	Fixed Network Element	NM	Network Management
FR	Functional Requirement	NMS	Network Management System
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
		VVoIP	Voice and Video over Internet Protocol

7.3 Information Assurance. The IA requirements for NE products are listed in Table 2-3. The IA requirements were derived from the UCR Section 5.9, Network Element Requirements, and UCR Section 5.4, IA Requirements.

Table 2-3. NE Products IA Requirements

Requirement	Critical (See Note.)	UCR Ref (UCR 2008 CH 2)
General Requirements	Yes	5.4.6.2
Authentication	Yes	5.4.6.2.1
Integrity	Yes	5.4.6.2.2
Confidentiality	Yes	5.4.6.2.3
Non-repudiation	Yes	5.4.6.2.4
Availability	Yes	5.4.6.2.5

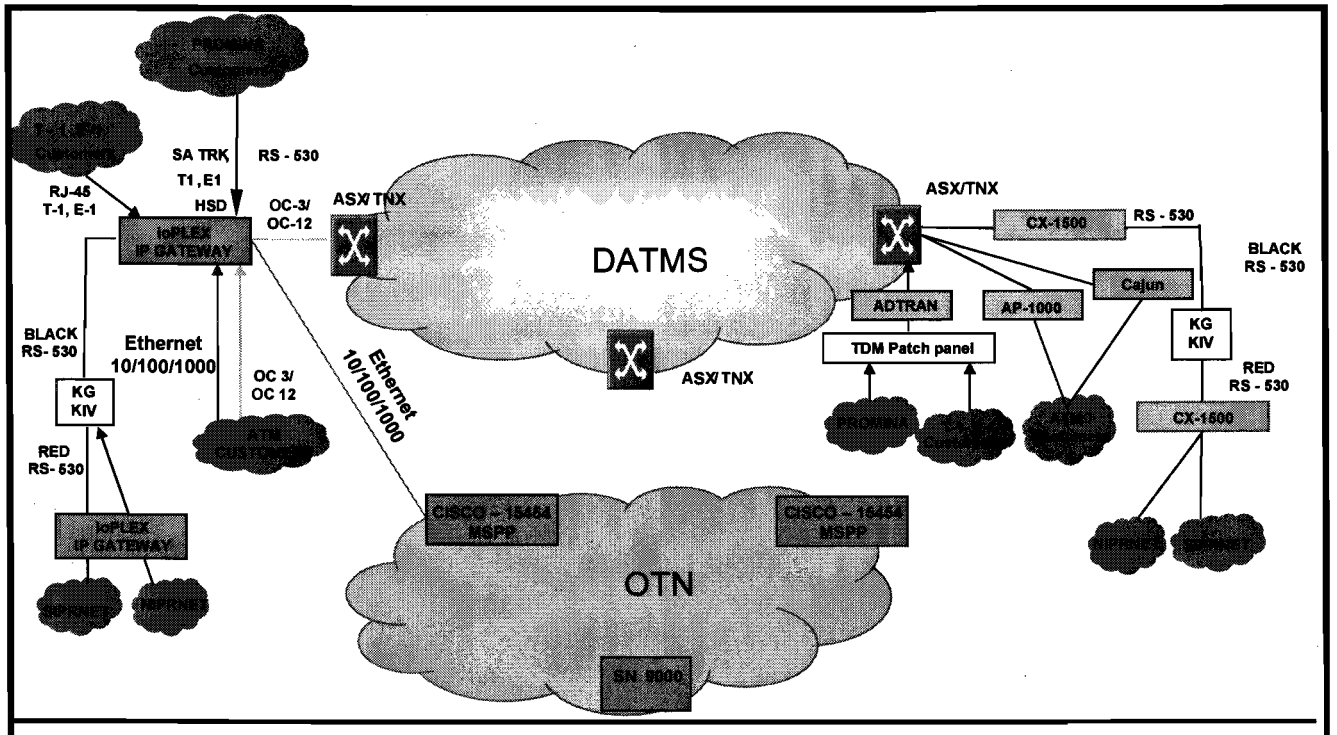
NOTE: Not all IA requirements from the referenced UCR section apply. Refer to Table 1 of the System Functional and Capability Requirements for the specific IA requirements.

LEGEND:

IA	Information Assurance	UCR	Unified Capabilities Requirements
NE	Network Element		

7.4 Other. Based on the Sponsors request JITC tested the SUT's ATM OC-X interfaces with the Defense Asynchronous Transfer Mode Systems (DATMS) for interoperability. MPLS was tested between SUT's Ethernet Egress interfaces through DISA Lab Riverstone (RS-8000) routers for MPLS interoperability.

8. TEST NETWORK DESCRIPTION. The JITC tested the SUT at DISA-Fort George G. Meade (FGGM) Testing Laboratory using test configurations shown in Figures 2-2 through 2-6. Figure 2-2 shows the DISA-FGGM, Test Bed, and Figure 2-3 through 2-6 shows the multiple SUT connectivity for UCR and interoperability test bed scenarios.



LEGEND:

AP-1000	Access Point	OC-3	Optical Carrier-3
ASX	Marconi ATM Switch	OC-12	Optical Carrier-12
ATM	Asynchronous Transfer Mode	OTN	Optical Transport Network
CX-1500	Cell Exchange 1500	RJ-45	Registered Jack- 45
DATMS	Defense Asynchronous Transfer Mode	RS-530	Recommended Standard- 530
E-1	European Standard 1	SA TRK	Serial Trunk
HSD	High Speed Data	SIPRNet	Secret Internet Protocol Router Network
IP	Internet Protocol	SN9000	Sycamore Networks 9000
KG	Cryptographic	T-1	T-Carriers 1
KIV	Type 1 Encryption Device	TDM	Time Division Multiplexing
MSPP	Multiservice Provisioning Platform	TNX	Marconi Multi-service Switch
NIPRNet	Non-Secure Internet Protocol Router Network	TRK	Trunk

Figure 2-2. DISA-FGGM Lab ioPLEX-1010 Test Bed

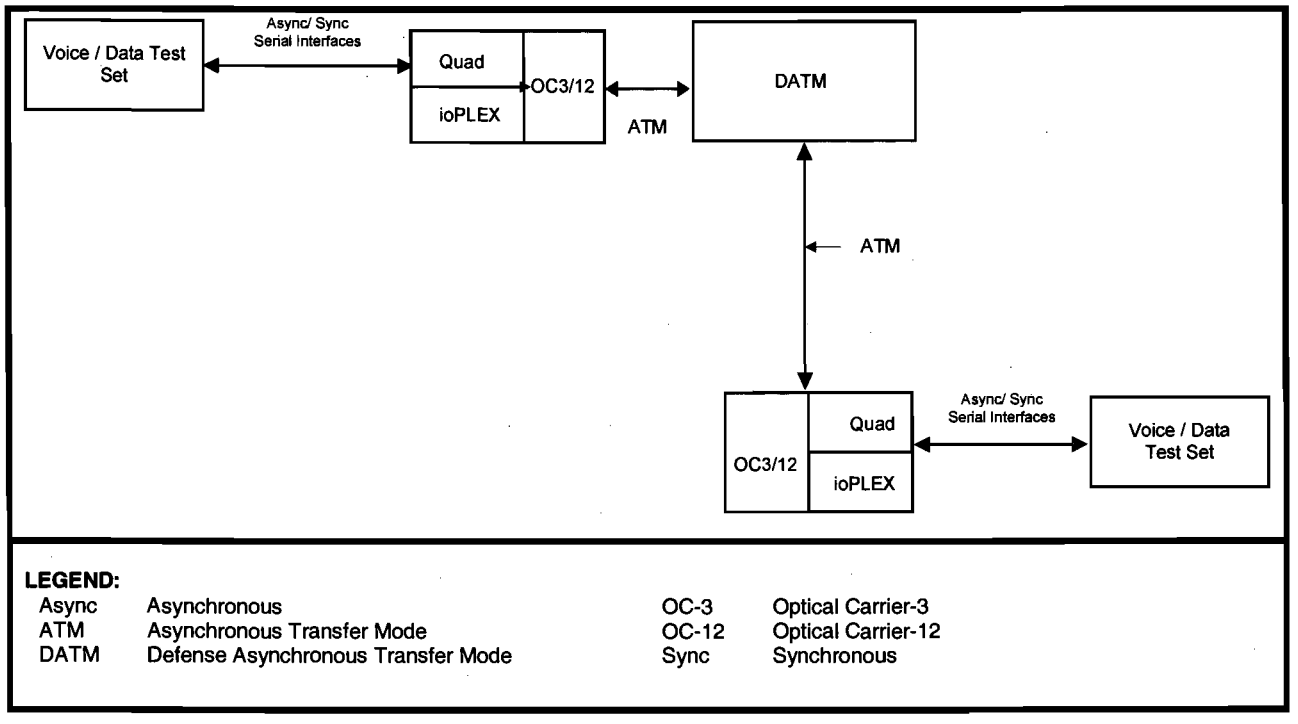


Figure 2-3. Avtec Systems ATM Configuration-1

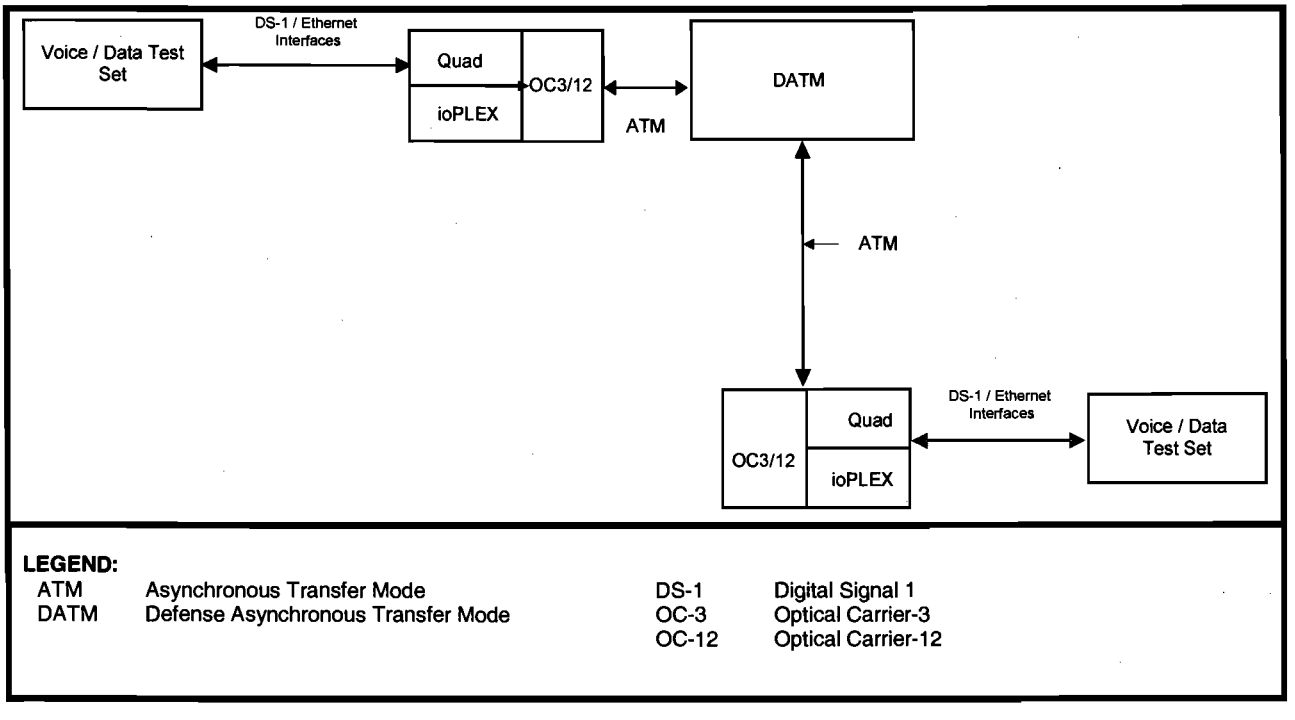


Figure 2-4. Avtec Systems ATM Configuration-2

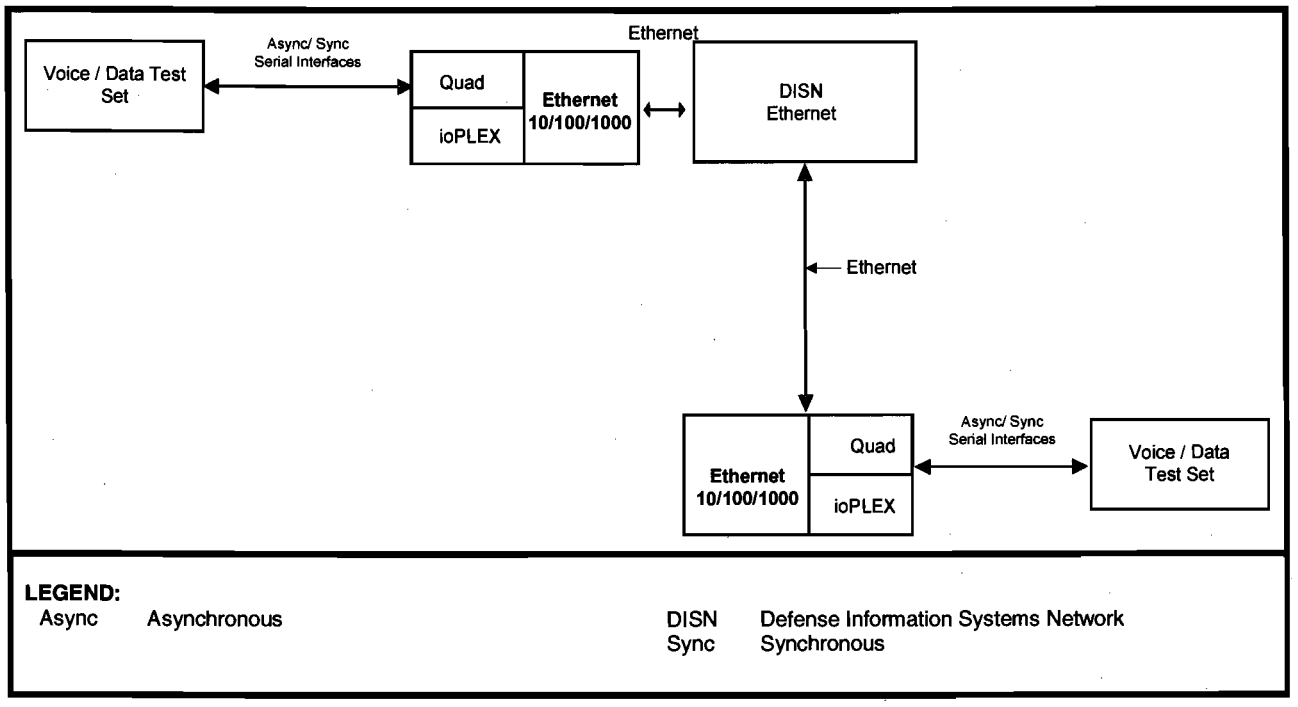


Figure 2-5. Avtec Systems Ethernet Configuration-1

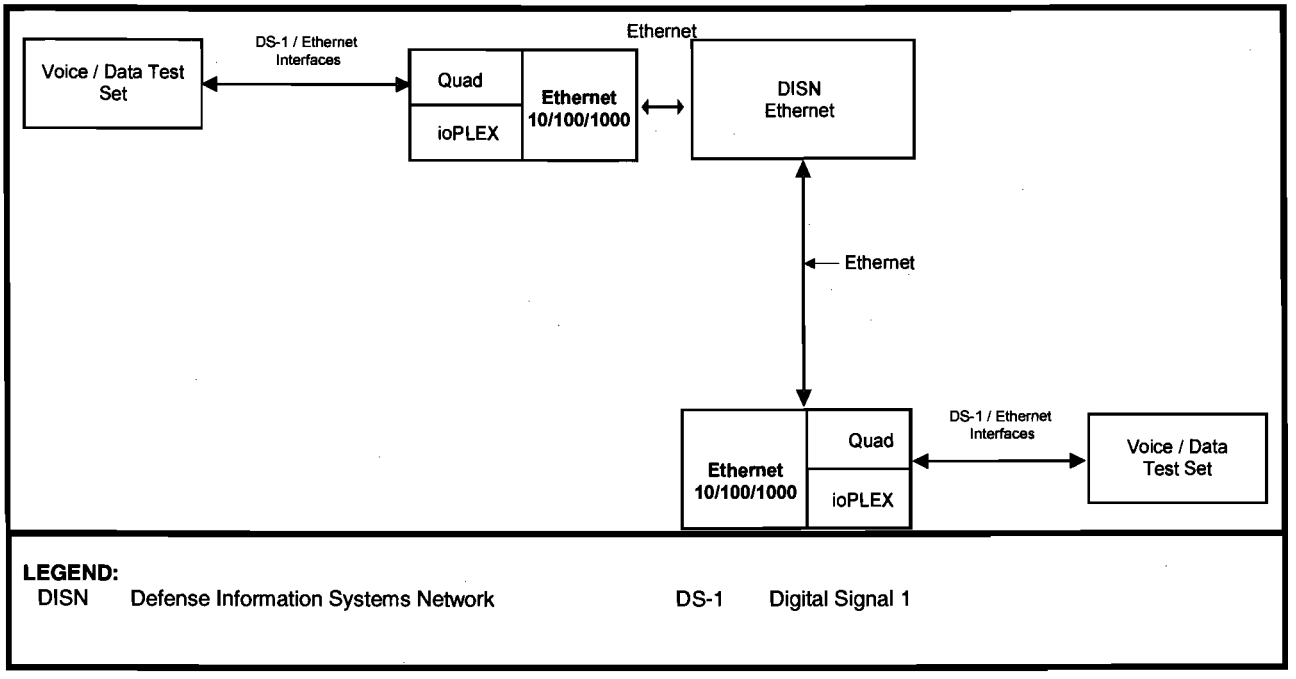


Figure 2-6. Avtec Systems Ethernet Configuration-2

9. SYSTEM CONFIGURATION. Table 2-4 lists the tested SUT configuration shown in Figure 2-2, Table 2-5 lists the DISN Core Equipment used to test the Avtec Systems ioPLEX 1010 F-NE solution, and Table 2-6 lists the test equipment used to generate voice, Synchronous Optical Network, and IP traffic.

Table 2-4. Tested SUT Equipment

Platform	Software Release	Function
Avtec Systems ioPLEX 1010	4.3.3	IP Access Gateway

LEGEND:
IP Internet Protocol

Table 2-5. 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 Tx, 10 x GigE LAN 1000 Base, 1x OC-192 SM SR2, 1 x 10GigE LAN, XENPAK
Cisco Catalyst 6500	12.1 (13)	48 E ports, 8 ports GigE, 2 port 10GigE
RedCom Switch	6.1	4 Port line card (MA0653-115) 2/ Multi E1/T1 (MET) Interface Board (MA0683-122 3/ Single Slot System Processor (S3P) Board/ line signaling Protocol for trunk lines (GR303 or SS7)(MA0688-101)

LEGEND:

DS	Digital Signal	OC-192	Optical Carrier-192
ETH	Ethernet	ODXC	Optical Digital Cross Connect
GigE	Gigabit Ethernet	R	Revision
LAN	Local Area Network	SM	Single Mode
LIM	Line Interface Module	SR	Short Reach
OC-3	Optical Carrier-3	STM	Synchronous Transport Module
OC-12	Optical Carrier-12	SUT	System Under Test
OC-48	Optical Carrier-48	Tx	Transmit
		USC	Universal Services Card

Table 2-6. Test Equipment

Manufacturer	Type	Port Type	Software Version
Agilent	Optical Tester	1550 nm	A.06.01
		1310 nm	
	Router Tester 900	OC-3/OC-12 /POS	6.11
		OC-48 Multilayer	
		1000 Base X	
Agilent	Rack Mounted Router Tester 900	10 Gig LAN/WAN	6.11
		10/100/1000 Base-T	
		1000 Base-X	
		OC-48c POS	
		OC-3/12/POS	
Agilent JDSU	T-Berd 8000	OC-192 POS	6.11
		DSU	6.4
		10/100/1000	
		OC-3-12	
		DS-3	
		OC-192	

LEGEND:

DS	Digital Signal	OC-3	Optical Carrier-3
DSU	Data Services Unit	OC-12	Optical Carrier-12
Gig	Gigabit	OC-48	Optical Carrier-48
JDSU	Vendor Name	OC-192	Optical Carrier-192
LAN	Local Area Network	POS	Packet Over Synchronous Optical Network
nm	nanometer	WAN	Wide Area Network

10. TEST LIMITATIONS. None

11. INTEROPERABILITY EVALUATION RESULTS. The SUT meets the critical interoperability requirements for F-NE and the JITC certifies it 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 2-7.

Table 2-7. SUT Interface Requirements Status

Interface	Critical (See note 1.)	UCR Reference	Threshold CR/FR Requirements (See note 2.)	Status	Remarks
Ingress (LAN side)					
Analog	No	5.9.3.2.1	1, 2, and 4	NA	Not supported by the SUT.
Serial	No	5.9.2.3.2	1, 2, and 4	Certified	SUT met requirements for specified interfaces.
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	NA	Not supported by the SUT.
OC-X	No	5.9.2.3.8	1, 2, 3, and 4	Certified	SUT met requirements for OC-3 and OC-12 ATM interfaces. See note 3.
IP (Ethernet) 10/100/1000	No	5.9.2.3.9	1, 2, 4, and 7	Certified	SUT met requirements for specified interfaces.
Egress (WAN side)					
Serial	No	5.9.2.3.2	1, 2, 3, and 4	Certified	SUT met requirements for specified interfaces.
DS1	No	5.9.2.3.4	1, 2, 3, and 4	Certified	SUT met requirements for specified interfaces.
E1	No	5.9.2.3.6	1, 2, 3, and 4	NA	Not supported by the SUT.
DS3	No	5.9.2.3.6	1, 2, 3, and 4	NA	Not supported by the SUT.
OC-X	No	5.9.2.3.8	1, 2, 3, and 4	Certified	SUT met requirements for OC-3 and OC-12 ATM interfaces. See note 3.
IP (Ethernet) 10/100/1000	No	5.9.2.3.9	1, 2, 4, and 7	Certified	SUT met requirements for specified interfaces.
DLoS	No	5.9.2.3.9	1, 2, 3, 4, and 5	NA	Not supported by the SUT.
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	

NOTES:
1. UCR does not specify any minimum interfaces. The SUT must minimally provide one of the listed ingress and egress interfaces specified.
2. CR/FR requirements are contained in Table 2. CR/FR numbers represent a roll-up of UCR requirements.
3. SUT supports ATM standards only for its OC-X interfaces so JITC tested OC-3 and OC-12 interface for ATM standards only.

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 System Level 1 (1.544 Mbps)	OC-X	Optical Carrier - X (OC-3, OC-12, etc.,)
DS3	Digital System Level 3 (44.736 Mbps)	OLT	Optical line Terminal
E1	European Interface Standard (2.048 Mbps)	SUT	System Under Test
FR	Functional Requirement	UCR	Unified Capabilities Requirements
Gbps	Gigabits per second	WAN	Wide Area Network

11.2 Capability Requirements (CR) and Functional Requirements (FR). The SUT's CR/FR statuses are listed in Table 2-8. The detailed CR/FR requirements are provided in Table 3-1 of the System Functional and Capability Requirements (Enclosure 3).

Table 2-8. SUT Capability Requirements and Functional Requirements Status

CR/FR ID	Capability/ Function	Applicability (See note 1.)	UCR Ref (UCR 2008 CH 2)	Status	Remarks
1	**General Network Elements 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	NA	Not supported by the SUT.
	Loop-Back Capability	Conditional	5.9.2.4.3	NA	Not supported by the SUT.
	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	**Deployed-Network Elements Requirements**				
	D-NE General Requirements	Required (See note 2.)	5.9.3.1	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	D-NE TDM Requirements	Conditional	5.9.3.2	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	D-NE IP Requirements	Conditional	5.9.3.3	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	Encapsulated TDM Requirements	Conditional	5.9.3.4	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	Carrier Group Alarms	Required (See note 2.)	5.9.3.5	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	Long-Local Requirements	Conditional	5.9.3.6	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	Proprietary IP Trunk Requirements	Conditional	5.9.3.7	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	Secure Call Handling	Required (See note 2.)	5.9.3.8	Not Tested	Sponsor requested to test the SUT as a fixed NE.
	Voice Packet Multiplexing	Conditional	5.9.3.9	Not Tested	Sponsor requested to test the SUT as a fixed NE.
7	**IPv6 Requirements**				
	Product Requirements	Required	5.3.5.4	Met	SUT is a layer-2 device and transports IPv4 and IPv6 traffic transparently.
8	**NM Requirements**				
	VVoIP NMS Interface Requirements	Required	5.3.2.4.4	Met	
	General Management Requirements	Required	5.3.2.17.2	Met	

Table 2-8. SUT Capability Requirements and Functional Requirements Status (continued)

NOTES:
1. Annotation of 'required' refers to high-level requirement category. Applicability of each sub-requirement is provided in enclosure 3.
2. Only applies if SUT seeking certification as a D-NE.

LEGEND:

ADPCM	Adaptive Differential Pulse Code Modulation	IPv4	Internet Protocol version 4
CR	Capabilities Requirement	IPv6	Internet Protocol version 6
DLoS	Direct Line of Sight	NE	Network Element
D-NE	Deployed Network Element	NM	Network Management
FR	Functional Requirement	NMS	Network Management System
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
IP	Internet Protocol		

a. General Network Elements Requirements

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

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

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

(c) The introduction of an NE(s) shall not degrade secure transmission for secure end devices as defined by UCR 2008, Change-2, Section 5.2.12.6, and DoD Secure Communications Devices. The JITC tested secure information exchanges by using DoD Secure Communications Devices such as Secure Telephone Unit (STU)/Secure Terminal Equipment (STE) devices.

(d) The NE(s) shall support a minimum modem transmission speed of 9.6 kbps across the associated NE(s). The 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). The JITC tested this information exchanges 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. The JITC tested this information exchanges by using an actual call control signals via a PBX T1 calls and simulated information exchanges with no noted issues.

(2) Alarms. IAW UCR 2008, Change-2, Section 5.9.2.1.1, the NE shall be able to propagate Carrier Group Alarms (CGA) and IAW UCR 2008, Change-2, Section 5.2.1.5.7, Carrier Group Alarm, upon physical loss of the Time Division Multiplexing (TDM) interface. 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, MAN) 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 equipment, and it propagates all Carrier Group Alarms IAW UCR 2008, Change-2, Section 5.2.1.5.7. 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, Change-2, Section 5.9.2.1.2, the NE shall ensure that congestion and latency between paired NEs does not affect DSN calls in progress or subsequent calls. Call congestion and latency requirements are as follows:

(a) 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, instead these are responsibility of connecting end equipments.

1. A dynamic load control signal (e.g., contact closure) shall be provided to the DSN switch in accordance with UCR 2008, Change-2, Section 5.9.2.1.2.

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

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

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

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

b. TDM ingress G.711 (non-secure calls) to transcoding TDM egress with compression codecs (IAW UCR 2008, Change 2, Section 5.9.2.2, Compression) 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 (Section 5.9.2.2, Compression) shall not increase delay by more than 250 ms per NE pair as measured E2E.

(b) IP Transport. The NE(s) using IP transport shall implement IP congestion control. Congestion may be controlled by using Differentiated Services, which shall be capable of providing preferential treatment for call congestion over other media types in accordance with IAW UCR 2008, Change 2, Section 5.3.3, Network Infrastructure E2E 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/egress requirements shall be met IAW UCR 2008, Change 2, Section 5.9.2.3.9, IP Interface. SUT is a layer-2 device and it passes all IP traffic transparently, therefore, none above IP transport requirement is applicable to the SUT, instead those are responsibility of connecting end equipments.

(c) Direct Line of Sight (DLoS) Transport. The SUT does not provide DLoS Transport. Therefore, the following DLoS congestion control requirements are not applicable.

1. 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) shall be provided to the DSN switch in accordance with IAW UCR 2008, Change 2, Section 5.9.2.1.2.1.

b. Congestion is not possible in the NE such that the maximum ingress throughput into the NE is configured such that 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.

2. The NE transporting only ingress IP traffic, and not using DLoS transport comprised of 802.11 a/b/g, 802.16-2004 (formerly 802.16d), or 802.16e-

2005, shall implement DLoS IP congestion control IAW UCR 2008, Change 2, Section 5.9.2.1.2.2. Additionally, IP congestion control may include a standards based or proprietary protocol between the NEs that will adjust the Quality of Service of the NE based on DLoS transport monitoring feedback to the NE to accommodate for changing environmental link conditions.

3. The NE transporting both TDM and IP ingress traffic simultaneously over the same DLoS transport link shall meet the following requirements:

a. 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/egress to the NE. Additionally, the congestion control may include a standards based or proprietary protocol between the NEs that will adjust the Quality of Service of the NE based on DLoS transport monitoring feedback to the NE to accommodate for changing environmental link conditions.

b. 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 IAW UCR 2008, Change 2,Section 5.9.2.1.2.1, For TDM Transport, and Section 5.9.2.3.9, IP Interface, respectively.

b. Compression. The SUT does not support Compression. Therefore, the following Compression requirements are not applicable.

(1) G.726.

(2) G.728.

(3) G.729.

c. Interface Requirements.

(1) Timing. IAW UCR 2008, Change-2, Section 5.9.2.3.7, The NE shall be able to derive timing signal from an internal source, an incoming digital signal, or an external source in accordance with UCR 2008, Change-2, Section 5.2.10.1, Timing Modes. This requirement applies to TDM interfaces only; IP interfaces does not need to meet this requirement.

d. Device Management. IAW UCR 2008, Change-2, Section 5.9.2.4, the SUT shall provide the following device management functions:

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

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

(b) Remote monitoring and management by the Advanced DSN Integrated Management Support System (ADIMSS) as described in the UCR 2008, Change-2, Section 5.2.8, Network Management, Section 5.2.8.3, Fault Management, and Section 5.2.8.4, Configuration Management. The 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.

(1) DLoS Transport. The SUT does not provide DLoS Transport. Therefore, the following DLoS congestion interface requirements are not applicable.

(a) Minimum MOS scores as defined IAW UCR 2008, Change 2, Section 5.9.2.1, General Requirements, performance requirement or better as measured in any 5-minute interval using P.862 testing standard.

(b) 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 shall be referred to as the NE DLoS transport MTR.

(c) A NE with only TDM interfaces that uses a DLoS transport link can be used to transport TDM only or IP over TDM access traffic.

f. Deployed Network Elements (D-NE) Requirements

(1) D-NE General Requirements. The D-NEs shall meet all NE requirements specified IAW UCR 2008, Change 2, Section 5.9.2, DSN F-NE Generic Requirements, except as modified by the following paragraphs. JITC did not verify this

capability because the Sponsor requested JITC test the SUT as an F-NE. Therefore, the following conditional D-NE requirements are not applicable.

(a) D-NE General Requirements. The D-NEs may include voice compression, IAW UCR 2008, Change 2, Section 5.9.2.2, Compression, to include the following additional compression standard: ITU-T Recommendation G.723.

(b) Network element latency requirements for various codecs are defined in UCR 2008, Change-2, Section 5.9.2, DSN F-NE Generic Requirements. The D-NE allows for one additional codec, G.723.1. The latency introduced by a single D-NE using the G.723.1 codec shall be less than 90 ms. The latency introduced by a pair of D-NEs using the G.723.1 codec shall be less than 180 ms.

(c) Voice calls placed through a set of D-NEs shall support a minimum MOS of 3.6 or better as measured in any 5-minute interval using the Perceptual Speech Quality Measure testing standard.

(d) The introduction of a D-NE shall not cause the E2E digital BER to degrade the Tactical BER below 1x10-5 by more than 0.03 percent as measured over a 9-hour period. This value does not include the application of Forward Error Correction (FEC) but is the minimum acceptable value for Tactical transmission before FEC is applied.

(e) The D-NE (when implemented in pairs) shall apply error correction to correct the errors interjected by the transport network between the two D-NEs such that the resulting BER of the external facing D-NE interface shall be better than 1x10-5 as measured over a 9-hour period.

(f) The NE shall assure congestion within 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:

1. A dynamic load control signal (e.g., contact closure) shall be provided to the DSN switch IAW UCR 2008, Change 2, Section 5.9.2.1.2, Congestion Control.

2. A software capability in limiting the provisioning the input and/or output interfaces such that makes congestion impossible even under the worst congestion scenario.

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

(2) D-NE TDM Requirements. IAW UCR 2008, Change-2, section 5.9.3.2, the D-NE shall support at least one of the interfaces listed in Section 5.9.2, DSN F-NE Generic Requirements. To be certified for use, TDM interfaces shall meet the interface

requirements for that specified interface. For interfaces provided, congestion control shall be provided as specified in Section 5.9.2.1.2, Congestion Control.

(3) D-NE IP Requirements. The D-NEs may use IP as a means to transport voice communications between D-NEs. The IP transport of voice services shall be one or more of the following methods: encapsulated TDM, long local, or PIPT. For any IP transport methods used, D-NEs using IP interfaces shall meet the following parameters: 1) the addition of D-NEs shall meet the latency criteria specified IAW UCR 2008, Change 2, Section 5.9.3, D-NE General Requirements. 2) The addition of a D-NE shall not cause jitter measured from ingress to egress to increase by more than 5 ms averaged over any 5-minute period. 3) The addition of a D-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.

(4) Encapsulated TDM Requirements. The D-NEs that use encapsulated TDM shall meet all the following requirements: 1) The D-NE shall use either differentiated services or integrated services to provide preferential treatment over IP transport. 2) The D-NE shall provide an IP bandwidth reservation/allocation mechanism to allow for the user-specified allocation of bandwidth to support the full non- blocking voice services requirement. 3) The D-NE shall implement IP congestion control. Congestion may be controlled by using differentiated services that shall be capable of providing preferential treatment for call congestion over other media types IAW UCR 2008, Change 2, Section 5.3.3, Network Infrastructure E2E Requirements, and a capability to limit the provisioning of input and output interfaces, so congestion is impossible under the worst transport congestion scenario.

(5) CGAs. IAW UCR 2008, Change-2, Section 5.9.3.5, the D-NE shall be able to propagate CGAs IAW Section 5.2.6, System Interfaces, upon physical loss of the ingress TDM interface. Voice switching systems, DSN or Deployed Voice Exchange (DVX), shall receive the proper CGAs from the D-NE upon loss of the IP transport link between D-NEs.

(6) Long-Local Requirements. IAW UCR 2008, Change-2, section 5.9.3.6, The D-NEs that provide a long local shall meet all the following requirements: 1) The D-NE shall provision features and functions to support the long-local device. 2) The D-NE shall allocate enough bandwidth to support the long-local device to ensure assured services and non-blocking requirements are met.

(7) Proprietary IP Trunk Requirements. IAW UCR 2008, Change-2, Section 5.9.3.7, the DVX VD-NE may use Proprietary IP signaling for this solution, and this interface shall support E2E ANSI T1.619a features and functions IAW UCR 2008, Change-2, Section 5.2.2.7, Integrated Services Digital Network Multi-Level Precedence and Preemption (MLPP) Primary rate Interface (i.e., Precedence, Preemption, MLPP Service Domain, Look Forward for Busy, Network Identifiers, and Coding Standard).

(8) Secure Call Handling. In processing Secure Communication Interoperability Protocol (SCIP) across conversion boundaries such as TDM to IP and/or IP to TDM, the D-NE shall utilize the V.150.1 standards implementation IAW National Security Agency SCIP-215 "U.S. Secure Communication Interoperability Protocol (SCIP) over IP Implementation Standard and Minimum Essential Requirements (MER) Publication" and SCIP 216 "Minimum Essential Requirements (MER) for V.150.1 Gateways Publication" for said ingress and egress conversions respectively. The secure call shall complete successfully as a minimum equal to or better than 85 percent of the time when used in the Deployed environment.

(9) Voice Packet Multiplexing. A D-NE that is equipped with voice packet multiplexing, where individual small IP voice packets (from either the same or multiple sources) may be combined into a single larger IP packet. The D-NE shall be configurable to allow the operator to specify the maximum latency and/or packet size to provide flexibility in the actual implementation. The intent is to allow the system to trade off additional latency incurred by this process for the gain in packet processing efficiency.

g. Internet Protocol version 6 (IPv6) Requirements.

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

h. NM Requirements. JITC verified the following NM requirements via a combination of testing and reviewing of the vendor submitted NM Letter of Compliance.

(1) Voice and Video over Internet Protocol (VVoIP) NMS Interface Requirements. IAW UCR 2008, Change-2, Section 5.3.2.4.4 the physical interface between the Defense Information Systems Agency VVoIP EMS and the network components (i.e., LSC, MFSS, EBC, 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. IAW UCR 2008, Change-2, Section 5.3.2.17.2, the SUT must support SNMPv3 format. A network appliance shall have Operations interfaces that provide a standard means by which management systems can directly or indirectly communicate with and, thus, manage the various network appliances in the DISN. The physical interface between the Local EMS and the VVoIP network components shall be an Ethernet connection IAW UCR 2008, Change 2, Section 5.3.2.4.4, VoIP NMS Interface Requirements. The physical interface between the VVoIP EMS and the VVoIP network components shall also be an Ethernet connection IAW UCR 2008, Change 2, Section 5.3.2.4.4. There shall be a local craftsperson interface (Craft Input Device for OA&M for all VVoIP network components.

11.3 Information Assurance. The IA Assessment Report is published as a separate report.

11.4 Other. JITC tested the SUT's ATM OC-3 and OC-12 interfaces with the Defense Asynchronous Transfer Mode Systems (DATMS) for interoperability based on Sponsor's ATM requirements, and found all requirements were met with the exception of the ATM/VC-MUX (Multiprotocol Encapsulation over ATM) was not supported by the OC-12. Therefore, JITC created a TDR. Vendor then supplied a new software fix, which JITC tested and found the OC-12 was fully functional and JITC closed the TDR. Layer 2 MPLS was tested between SUT's Ethernet Egress interfaces through DISA Lab Riverstone (RS-8000) routers for Layer 2 MPLS interoperability based on Sponsor's MPLS requirements and found SUT met all the requirements.

12. TEST AND ANALYSIS REPORT. In accordance with the Program Manager's request, JITC did not prepare a detailed test report. JITC distributes interoperability information via the JITC Electronic Report Distribution system, which uses Non-secure Internet Protocol Router Network (NIPRNet) e-mail. More comprehensive interoperability status information is available via the JITC System Tracking Program (STP), 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.

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SYSTEM FUNCTIONAL AND CAPABILITY REQUIREMENTS

The Network Elements (NE), Fixed Network Elements, and Deployed Network Elements 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 NEs are listed in Table 3-1. Detailed Information Assurance (IA) requirements are included in Reference (e) and are not listed below.

Table 3-1. NE Capability/Functional Requirements Table

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE	D-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	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	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	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	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	R
6	The NE shall transport all call control signals transparently on an E2E basis.	5.9.2.1 (6)	R	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	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	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	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	R

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

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	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	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 COTgenerated DC contact closure alarm to indicate an "all-accessible-channelsbusy" condition.	5.9.2.1.2.1 (1A1)	C	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	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	C

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

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE	D-NE
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	C
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 (nonsecure calls) to nontranscoding 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 (nonsecure 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 nontranscoding 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	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	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	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	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	C

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

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	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	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	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 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.	5.9.2.3.1 (1)	C	C
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	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	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	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	C

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

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE	D-NE
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 inband signaling shall be provided on individual channels. The D5 format shall be the preferred and system "goal" digital framing format and shall be provided in accordance with MIL-STD-187-700. 1. Interface Characteristics: The NE shall use the DS1 24 channel standard interface as specified in ANSI T1.102, "Digital Hierarchy – Electrical Interfaces." Table 5.9.2.3.4-1, PCM-24 Electrical Interface Characteristics, provides the electrical characteristics at the interface. Table 5.9.2.3.4-2 and Table 5.9.2.3.4-3 provide a listing of the framing characteristics. (Please see UCR 2008, Change-2,-Pages 1898 thru 1900)	5.9.2.3.4	C	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 and the "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. 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.	5.9.2.3.4 (2)	C	C
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	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 Table5.9.2.3.4-4, PCM-24 Alarm and Restoral Requirements. (Please see UCR 2008, Change-2,-Page 1901)	5.9.2.3.4 (4)	C	C

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

23	If provided, the NE shall meet the following E1 interface requirements and conditions of a PCM-30 Digital Trunk Interface: PCM-30 Digital Trunk Interface: The NE shall provide PCM-30 digital interfaces at a data rate of 2.048 Mbps. The PCM-30 interfaces shall meet the requirements of ITU-T Recommendation G.703 and ITU-T Recommendation G.732. Voice signals in the PCM-30 framing format shall utilize the A-law encoding technique in accordance with ITU-T Recommendation G.772 (REV), "Protected Monitoring Points on Digital Transmission Systems." The pertinent requirements for the PCM-30 interface are summarized in Table 5.9.2.3.5-1, PCM-30 Electrical Interface Characteristics. (Please see UCR 2008, Change-2,-Page 1902)	5.9.2.3.5	C	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	C
23B	2. Alarm and Restoral Requirements: The NE shall provide the alarm and restoral features on the DIU in order to be compatible with PCM-30 facilities and terminal equipment, as shown in Table 5.9.2.3.5-3, PCM-30 Alarm and Restoral Requirements. (Please see UCR 2008, Change-2,-Page 1903)	5.9.2.3.5 (2)	C	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	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	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	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. 5.3.2.12.14.1.2.2 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.	5.9.2.3.7	R	R
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	C

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

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	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 (nonsecure calls) to nontranscoding 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 (nonsecure 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	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	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	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	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	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	C

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

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE	D-NE
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: ** 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.	5.9.2.4.1	R	R
31	The NE shall report any failure of self-test diagnostic function on nonactive and active channels on a noninterference basis to the assigned NMS.	5.9.2.4.2	C	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	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	R

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

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	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	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	R
37	1. If a DoD-approved WIDS exists for the DLoS transport technology used, the NE DLoS transport link(s) shall be monitored in according with the appropriate STIG(s).	5.9.2.7	C	C
38	1. The D-NEs shall meet all NE requirements specified in Section 5.9.2, DSN FNE Generic Requirements, except as modified by the following paragraphs. The D-NEs shall be tested under a simulated Deployed environment using the operational area network (OAN) architecture framework and the following parameters: a. Inclusion of satellite-based transmission links. With respect to D-NE testing, the following parameters will be used when injecting burst errors into the network. The D-NE being tested shall continue to function as specified in Section 5.9.2.1, General Requirements, and Section 5.9.3.1, D-NE General Requirements, during such testing: (1) Error Burst Density. The D-NE measured error burst density shall be 1x10-6. (2) Error Burst Gap (gap between error bursts in ms). The measured D-NE error burst gap shall be 600 ms. (3) Error Burst Length (length of error burst in ms). The measure D-NE error burst length shall be 500 ms.	5.9.3	NA	R
39	The D-NEs may include voice compression, as specified in Section 5.9.2.2, Compression, to include the following additional compression standard: ITU-T Recommendation G.723.	5.9.3.1 (1)	NA	C
40	2. Network element latency requirements for various codecs are defined in Section 5.9.2, DSN F-NE Generic Requirements. The D-NE allows for one additional codec, G.723.1. The latency introduced by a single D-NE using the G.723.1 codec shall be less than 90 ms. The latency introduced by a pair of D-NEs using the G.723.1 codec shall be less than 180 ms.	5.9.3.1 (2)	NA	C

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

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE	D-NE
41	Voice calls placed through a set of D-NEs shall support a minimum MOS of 3.6 or better as measured in any 5-minute interval using the Perceptual Speech Quality Measure (PSQM) testing standard.	5.9.3.1 (3)	NA	R
42	The introduction of a D-NE shall not cause the E2E digital BER to degrade the Tactical BER below 1x10-5 by more than 0.03 percent as measured over a 9-hour period. This value does not include the application of Forward Error Correction (FEC) but is the minimum acceptable value for Tactical transmission before FEC is applied.	5.9.3.1 (4)	NA	R
43	The D-NE (when implemented in pairs) shall apply error correction to correct the errors interjected by the transport network between the two D-NEs so the resulting BER of the external facing D-NE interface shall be better than 1x10-5 as measured over a 9-hour period.	5.9.3.1 (5)	NA	R
44	The NE shall assure congestion within 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: a. A dynamic load control signal (e.g., contact closure) shall be provided to the DSN switch IAW Section 5.9.2.1.2, Congestion Control. b. A software capability in limiting the provisioning of the input and/or output interfaces that make congestion impossible even under the worst congestion scenario. c. Congestion is not possible in the NE by the nature of its functioning (e.g., a TDM multiplexer or transcoder).	5.9.3.1 (6)	NA	R
45	The D-NE shall support at least one of the interfaces listed in Section 5.9.2, DSN F-NE Generic Requirements. To be certified for use, TDM interfaces shall meet the interface requirements for that specified interface. For interfaces provided, congestion control shall be provided as specified in Section 5.9.2.1.2, Congestion Control.	5.9.3.2	NA	C
46	The D-NEs may use IP as a means to transport voice communications between D-NEs. Interfaces supporting IP shall meet the appropriate specifications for that physical interface as stipulated in the latest DISR Baseline Release. The IP transport of voice services across D-NEs shall be accomplished through any one or more of the following methods: encapsulated TDM, long local, or Proprietary Internet Protocol Trunk (PIPT).	5.9.3.3 (1)	NA	C
47	For any IP transport methods used, D-NEs using IP interfaces shall meet the following parameters: a. The addition of D-NEs shall meet the latency criteria specified in Section 5.9.3, D-NE General Requirements. b. The addition of a D-NE shall not cause jitter measured from ingress to egress to increase by more than 5 ms averaged over any 5-minute period. c. The addition of a D-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.	5.9.3.3 (3)	NA	R
48	The D-NE shall use either DiffServ or integrated services to provide preferential treatment over IP transport.	5.9.3.4 (1)	NA	R
49	The D-NE shall provide an IP bandwidth reservation or allocation mechanism to allow for the user-specified allocation of bandwidth to support the full nonblocking voice services requirement.	5.9.3.4 (2)	NA	R
50	The D-NE shall implement IP congestion control. Congestion may be controlled by using DiffServ that 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.	5.9.3.4 (3)	NA	R
51	The D-NE shall be able to propagate CGAs IAW Section 5.9.2.1.1, Alarms, upon physical loss of the ingress TDM interface.	5.9.3.5	NA	R
52	Voice switching systems, DSN or DVX, shall receive the proper CGAs from the D-NE upon loss of the IP transport link between D-NEs.	5.9.3.5	NA	R

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

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE	D-NE
53	The D-NEs that provide a long local shall meet all the following requirements: 1. The D-NE shall provision features and functions to support the longlocal device. 2. The D-NE shall allocate enough bandwidth to support the long-local device to ensure assured services and nonblocking requirements are met.	5.9.3.6	NA	R
54	The DVX VD-NE may use proprietary IP signaling for this solution, and this interface shall support E2E ANSI T1.619a features and functions IAW Section 5.3.2.31.3.7, ISDN MLPP PRI (i.e., Precedence, Preemption, MLPP Service Domain, Look Forward for Busy, Network Identifiers, and Coding Standard). The PIPT shall meet the appropriate specifications for IP voice signaling method protocols (i.e., H.323, Session Initiation Protocol, Version 2 (SIPv2)), as stipulated in the latest DISR Baseline Release to establish the virtual IP trunk session. Until a complete set of standards exists for MLPP over IP, initially vendors may implement proprietary protocols across the PIPT to ensure the complete MLPP functionality as detailed in, Section 5.3.2., is provided to the DSN IP telephony subscriber.	5.9.3.7 (1)	NA	C
55	For DVX VD-NE switches that do not support MLPP, this interface shall support end-to-end ISDN PRI National ISDN 1/2 (NI ½) features and functions (i.e., Bearer, Calling Number Delivery). The PIPT shall meet the appropriate specifications for IP voice signaling method protocols (i.e., H.323, SIPv2), as stipulated in the latest DISR Baseline Release to establish the virtual IP trunk session.	5.9.3.7 (2)	NA	C
56	In processing secure calls (SCIP) across conversion boundaries, such as TDM to IP and/or IP to TDM, the D-NE shall use the V.150.1 standards implementation IAW.NSA SCIP-215 and SCIP 216 for said ingress and egress conversions, respectively. The D-NE shall support this NSA V.150.1 implementation capability on all D-NE interface ports where secure call conversion can occur. The secure call handling implementation on the D-NE also shall meet the requirements of Section 5.9.2.1, sub-requirement 3.	5.9.3.8 (1)	NA	R
57	The secure call shall complete successfully as a minimum equal to or better than 85 percent of the time when used in the Deployed environment.	5.9.3.8 (2)	NA	R
58	A D-NE that is equipped with voice packet multiplexing, where individual small IP voice packets (from either the same or multiple sources) may be combined into a single larger IP packet. The D-NE shall be configurable to allow the operator to specify the maximum latency and/or packet size to provide flexibility in the actual implementation. The intent is to allow the system to trade off additional latency incurred by this process for the gain in packet processing efficiency.	5.9.3.9	NA	C

LEGEND:

ADIMSS	Advanced DSN Integrated Management Support System	IP	Internet Protocol
ANSI	American National Standards Institute	ISDN	Integrated Services Data Network
APL	Approved Product List	ITU	International Telecommunications Union
ASLAN	Assured Services LAN	ITU-T	ITU Telecommunications Union - Telecommunications Sector
BER	Bit Error Rate	LAN	Local Area Network
BRI	Basic rate Interface	MAN	Metropolitan Area Networks
C	Conditional	MLPP	Multi-Level Precedence and Preemption
CE	Customer Edge	MOS	Mean Opinion Score
CGA	Carrier Group Alarm	Ms	Millisecond
CH	Change	NMS	Network Management System
D-NE	Deployed-Network Element	NSA	National Security Agency
DAA	Designated Approving Authority	PCM	Pulse Code Modulation
DISR	DoD Information technology Standards and Profile Registry	PRI	Primary rate Interface
		R	Required
DoD	Department of Defense	SCIP	Secure Communication Interoperability Protocol
DoDI	DoD Instruction	SONET	Synchronous Optical Network
DSN	Defense Switched Network	STIG	Security Technical implementation Guide

ID	Requirement	UCR Ref (UCR 2008 CH 2)	F-NE	D-NE

DVX	Deployed Voice Exchange	T1	Trunk 1 (1544 bps, 24-channel PCM)
E1	European 1 (2048 bps, 30-channel PCM)	TDM	Time Division Multiplexing
E2E	End to End	UCCO	Unified Capabilities Certification Office
F-NE	Fixed-Network Element	UCR	Unified Capabilities Requirements
FIPS	Federal Information Processing Standard	VVoIP	Voice and Video over Internet Protocol
IAW	In Accordance With		

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