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

MEMORANDUM FOR DISTRIBUTION **15 Jul 11**

SUBJECT: Special Interoperability Test Certification of the Juniper Networks MX Series with Software Release Junos™ 10.0R4.7 Customer Edge Router (CER)

References: (a) DoD Directive 4630.05, "Interoperability and Supportability of Information Technology (IT) and National Security Systems (NSS)," 5 May 2004
(b) CJCSI 6212.01E, "Interoperability and Supportability of Information Technology and National Security Systems," 15 December 2008
(c) through (g), 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 Juniper Networks MX480 with Software Release Junos™ 10.0R4.7 is hereinafter referred to as the System Under Test (SUT). The SUT meets all of its critical interoperability requirements for joint use within the Defense Information System Network (DISN) as a High Availability CER. When a CER meets the High Availability CER requirements, it is also certified as a Medium Availability with System Quality Factors (SQF), Medium Availability without SQF, and Low Availability CER. The SUT met all four categories of CER with a single chassis. The SUT meets the critical interoperability requirements set forth in Reference (c), using test procedures derived from Reference (d). The SUT met the critical interoperability requirements for the following interfaces: Institute of Electrical and Electronics Engineers (IEEE) 802.3i (10BaseT), IEEE 802.3u (100BaseT), and IEEE 802.3ab (1000BaseT). The MX240 and MX960 routers employ the same software and similar hardware as the MX480 router. The JITC analysis determined these systems to be functionally identical to the SUT for interoperability certification purposes and they are also certified for joint use. No other configurations, features, or functions, except those cited within this memorandum, are certified by JITC. This certification expires upon changes that could affect interoperability, but no later than three years from the date the DISA Certifying Authority (CA) provided a positive Recommendation.

3. This finding is based on interoperability testing conducted by JITC, review of the vendor's Letters of Compliance (LoC), and DISA Information Assurance (IA) CA approval of the IA configuration. Interoperability testing was conducted by JITC, Fort Huachuca, Arizona, from 27 December 2010 through 7 January 2011. Review of the vendor's LoC was completed on 11 March 2011. The DISA CA reviewed the IA Assessment Reports for the SUT, References (e), (f), and (g), and provided a positive recommendation on 19 April 2011. The acquiring agency or site will be responsible for the DoD Information Assurance Certification and Accreditation

Process (DIACAP) accreditation. Enclosure 2 documents the test results and describes the tested network and system configurations including specified patch releases.

4. The interface, Capability Requirement (CR) and Functional Requirement (FR), and component status of the SUT are listed in Tables 1 and 2. The threshold Capability/Functional requirements for CERs are established by in Section 5.3.2.14 of Reference (c) and were used to evaluate the interoperability of the SUT. Enclosure 3 provides a detailed list of the interface, capability, and functional requirements.

Table 1. SUT Interface Interoperability Status

Interface	Critical	UCR Reference	Threshold CR/FR Requirements (See note.)	Status	Remarks
ASLAN Interfaces					
10Base-X	Yes	5.3.2.4.2 5.3.2.14.9	1-3	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3i (10BaseT) interface.
100Base-X	Yes	5.3.2.4.2 5.3.2.14.9	1-3	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3u (100BaseT) interface.
1000Base-X	No	5.3.2.4.2 5.3.2.14.9	1-3	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3ab (1000BaseT) interface.
WAN Interfaces					
10Base-X	Yes	5.3.2.4.2 5.3.2.14.9	1-3	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3i (10BaseT) interface.
100Base-X	Yes	5.3.2.4.2 5.3.2.14.9	1-3	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3u (100BaseT) interface.
1000Base-X	No	5.3.2.4.2 5.3.2.14.9	1-3	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3ab (1000BaseT) interface.
DS1	No	5.3.2.14.9	1-2	Not Tested	The SUT does not support this interface and it is not required.
DS3	No	5.3.2.14.9	1-2	Not Tested	The SUT does not support this interface and it is not required.
E1	No	5.3.2.14.9	1-2	Not Tested	The SUT does not support this interface and it is not required.
OC-X	No	5.3.2.14.9	1-2	Not Tested	This interface was not tested and is not required.
Network Management Interfaces					
10Base-X	Yes	5.3.2.4.4	4	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3i (10BaseT) interface. This was met by the vendor's LoC.
100Base-X	Yes	5.3.2.4.4	4	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3u (100BaseT) interface. This was met by the vendor's LoC.
1000Base-X	No	5.3.2.4.4 5.3.2.14.9	4	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3ab (1000BaseT) interface. This was met by the vendor's LoC.

NOTE: The annotation of 'required' refers to a high-level requirement category. The applicability of each sub-requirement is provided in Enclosure 3.

LEGEND:

ASLAN	Assured Services Local Area Network	IEEE	Institute of Electrical and Electronics Engineers
CER	Customer Edge Router	LoC	Letters of Compliance
CR	Capability Requirement	OC	Optical Carrier
DS1	Digital Signal Level 1 (1.544 Mbps)	SUT	System Under Test
DS3	Digital Signal Level 3	UCR	Unified Capabilities Requirements
FR	Functional Requirement	WAN	Wide Area Network

Table 2. SUT CRs and FRs Status

CR/FR ID	Capability/ Function	Applicability (See note 1.)	UCR Reference	Status	Remarks
Product Interface Requirements					
1	Internal Interface Requirements	Required	5.3.2.4.1	Met	The SUT met all critical CRs and FRs.
	External Physical Interfaces between Network Components	Required	5.3.2.4.2	Met	The SUT met all critical CRs and FRs.
	IP Queue Control Capabilities	Required	5.3.2.17.3.4.2. 12 para 1	Met	The SUT met all critical CRs and FRs.
	Differentiated Services Code Point	Required	5.3.3.3.2	Met	The SUT met all critical CRs and FRs.
	VVoIP Per-Hop Behavior Requirements	Required	5.3.3.3.3	Met	The SUT met all critical CRs and FRs.
	Traffic Conditioning Requirements	Required	5.3.3.3.4	Met	The SUT met all critical CRs and FRs.
Customer Edge Router Requirements					
2	Traffic Conditioning	Required	5.3.2.14.1	Met	The SUT met all critical CRs and FRs.
	Differentiated Services Support	Required	5.3.2.14.2	Met	The SUT met all critical CRs and FRs.
	Per Hop Behavior Support	Required	5.3.2.14.3	Met	The SUT met all critical CRs and FRs.
	Interface to the LSC/MFSS for Traffic Conditioning	Conditional	5.3.2.14.4	Not Tested	The SUT does not support this feature and it is not required.
	Interface to the LSC/MFSS for Bandwidth Allocation	Conditional	5.3.2.14.5	Not Tested	The SUT does not support this feature and it is not required.
	Availability	Required	5.3.2.14.7	Met	The SUT met all critical CRs and FRs. The SUT met High Availability CER requirements.[2]
	Packet Transit Time	Required	5.3.2.14.8	Met	The SUT met all critical CRs and FRs.
	CER Interfaces and Throughput Support	Required	5.3.2.14.9	Met	The SUT met all critical CRs and FRs.
	Assured VVoIP Latency	Required	5.3.3.4	Met	The SUT met all critical CRs and FRs.[5]
	Assured VVoIP CE Latency	Required	5.3.3.4.2	Met	The SUT met all critical CRs and FRs.[5]
	Assured VVoIP CER-to-CER Latency	Required	5.3.3.4.4	Met	The SUT met all critical CRs and FRs.[5]
	Assured VVoIP CER-to-CER Jitter	Required	5.3.3.5.3	Met	The SUT met all critical CRs and FRs.[5]
	Assured VVoIP CE Jitter	Required	5.3.3.5.4	Met	The SUT met all critical CRs and FRs.[5]
	Assured VVoIP CER-to-CER Packet Loss	Required	5.3.3.6.3	Met	The SUT met all critical CRs and FRs.[5]
	Assured VVoIP CE Packet Loss	Required	5.3.3.6.4	Met	The SUT met all critical CRs and FRs.[5]
	End-to-End Availability	Required	5.3.3.12.1	Met	The SUT met all critical CRs and FRs.[5]
	Availability Design Factors	Required	5.3.3.12.2	Met	The SUT met all critical CRs and FRs.[5]
	Product Quality Factors	Required	5.3.3.12.3	Met	The SUT met all critical CRs and FRs.[5]
	Layer 1 – Physical Layer	Required	5.3.3.12.4.1	Met	The SUT met all critical CRs and FRs.[5]
	Layer 2 – Data Link Layer	Required	5.3.3.12.4.2	Met	The SUT met all critical CRs and FRs.[5]
	Provisioning	Required	5.3.3.13	Met	The SUT met all critical CRs and FRs.[5]
	Interchangeability	Required	5.3.3.14	Met	The SUT met this requirement with Static Routing, BGP-4, IS-IS, OSPFv2, OSPFv3, and VRRP.
	Voice Grade of Service	Required	5.3.3.15	Met	The SUT met all critical CRs and FRs.[5]
	Survivability	Required	5.3.3.16	Not Tested	This is an E2E engineering requirement and is not testable in a lab environment.[3]

Table 2. SUT CRs and FRs Status

CR/FR ID	Capability/ Function	Applicability (See note 1.)	UCR Reference	Status	Remarks
Internet Protocol Version 6 Requirements					
3	IPv6	Required	5.3.3.10	Met	The SUT met all critical CRs and FRs with the following minor exception: The SUT does not fully support IPv4 functions in IPv6.[4]
	Product Requirements	Required	5.3.5.4	Met	The SUT met all critical CRs and FRs.
Network Management Requirements					
4	VVoIP NMS Interface Requirements	Required	5.3.2.4.4	Met	The SUT met all critical CRs and FRs for the 10/100/1000BaseT interfaces. This was met by vendor's LoC.
	NM Requirements for CERs	Required	5.3.2.18.1	Met	The SUT met all critical CRs and FRs for the 10/100/1000BaseT interfaces. This was met by vendor's LoC.
	Network Management	Required	5.3.2.14.6	Met	The SUT met all critical CRs and FRs for the 10/100/1000BaseT interfaces. This was met by vendor's LoC.

NOTES:
1. The annotation of 'required' refers to a high-level requirement category. The applicability of each sub-requirement is provided in Enclosure 3.
2. If a CER meets the High Availability CER requirements, it meets all of the lesser requirements for Medium Availability with and without SQF and Low Availability. To meet the High Availability and Medium Availability with SQF, the SUT needs to be in a dual chassis configuration.
3. This is an E2E engineering requirement and, due to variations in network architectures, it could not be accurately tested in a lab environment. To meet E2E requirements, the SUT must be deployed in accordance with its deployment guide and the engineering guidelines provided in UCR Section 5.3.3.
4. The UCR 2008, Change 2, Section 5.3.5.4, paragraph 1.4, states that the products which provide a function in IPv4 will have to provide the same function in a seamless manner in IPv6. Per the vendor's LoC they stated that they partially comply with this requirement, and will determine exactly what the deltas are between Ipv4 and IPv6. In the interim this discrepancy was adjudicated by DISA on 22 April 2011 as having a minor operational impact since interoperability testing did not identify any critical anomalies due to this discrepancy.
5. This requirement was verified in an operational emulated environment. To meet E2E requirements, the SUT must be deployed in accordance with its deployment guide and the engineering guidelines provided in UCR Section 5.3.3.

LEGEND:

BGP	Border Gateway Protocol	LoC	Letters of Compliance
CE	Customer Edge	LSC	Local Session Controller
CER	Customer Edge Router	MFSS	Multifunction Softswitch
CR	Capability Requirement	NM	Network Management
DISA	Defense Information Systems Agency	NMS	Network Management System
E2E	End-to-End	POA&M	Plan of Actions and Milestones
EBC	Edge Boundary Controller	OSPF	Open Shortest Path First
FR	Functional Requirement	SQF	System Quality Factors
ID	Identification	SUT	System Under Test
IP	Internet Protocol	UCR	Unified Capabilities Requirements
IPv4	Internet Protocol version 4	VRRP	Virtual Router Redundancy Protocol
IPv6	Internet Protocol version 6	VVoIP	Voice and Video over Internet Protocol
IS-IS	Intermediate System-Intermediate System		

5. No detailed test report was developed in accordance with the Program Manager's request. JITC distributes interoperability information via the JITC Electronic Report Distribution (ERD) system, which uses Unclassified-But-Sensitive Internet Protocol Router Network (NIPRNet) e-mail. More comprehensive interoperability status information is available via the JITC System Tracking Program (STP). The STP is accessible by .mil/gov users 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 (JIT) at https://jit.fhu.disa.mil (NIPRNet).

JITC Memo, JTE, Special Interoperability Test Certification of the Juniper Networks MX Series with Software Release Junos™ 10.0R4.7 Customer Edge Router (CER)

Information related to DSN testing is on the Telecom Switched Services Interoperability (TSSI) website at http://jitc.fhu.disa.mil/tssi. Due to the sensitivity of the information, the Information Assurance Accreditation Package (IAAP) that contains the approved configuration and deployment guide must be requested directly through government civilian or uniformed military personnel from the Unified Capabilities Certification Office (UCCO), e-mail: ucco@disa.mil.

6. The JITC point of contact is Mr. Khoa Hoang, DSN 879-4376, commercial (520) 538-4376, FAX DSN 879-4347, or e-mail to khoa.hoang@disa.mil. The JITC's mailing address is P.O. Box 12798, Fort Huachuca, AZ 85670-2798. The Tracking Number for the MX480 is 1020801. The Tracking Number for the MX240 is 1016502. The Tracking Number for the MX960 is 1020802.

FOR THE COMMANDER:

3 Enclosures a/s

for BRADLEY A. CLARK
Chief
Battlespace Communications Portfolio

JITC Memo, JTE, Special Interoperability Test Certification of the Juniper Networks MX Series with Software Release Junos™ 10.0R4.7 Customer Edge Router (CER)

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Defense Information Systems Agency, GS23

ADDITIONAL REFERENCES

(c) Office of the Assistant Secretary of Defense, "Department of Defense Unified Capabilities Requirements 2008, Change 2," 22 January 2010
(d) Joint Interoperability Test Command, "Unified Capabilities Test Plan (UCTP)," Draft
(e) Joint Interoperability Test Command, "Information Assurance (IA) Assessment of Juniper Modular Expansion (MX) 480 Juniper Operating System (JUNOS) 10.0 (Tracking Number 1020801),"
(f) Joint Interoperability Test Command, "Information Assurance (IA) Assessment of Juniper Modular Expansion (MX) 240 Juniper Operating System (JUNOS) 10.0 (Tracking Number 1016502),"
(g) Joint Interoperability Test Command, "Information Assurance (IA) Assessment of Juniper Modular Expansion (MX) 960 Juniper Operating System (JUNOS) 10.0 (Tracking Number 1020802),"

CERTIFICATION TESTING SUMMARY

1. SYSTEM TITLE. The Juniper Networks MX Series with Software Release Junos™ 10.0R4.7 Customer Edge Router (CER); hereinafter referred to as the System Under Test (SUT).

2. SPONSOR. Defense Information Systems Agency (DISA) NS3 Real Time Services Division.

3. SYSTEM POC. Mr. Bill Shelton, 2251 Corporate park Drive, Suite 100, Herndon Virginia 20171, e-mail: bshelton@juniper.net

4. TESTER. Joint Interoperability Test Command (JITC), Fort Huachuca, Arizona.

5. SYSTEM DESCRIPTION. The Unified Capabilities Requirements (UCR) defines a CER as a router located at the boundary between the Edge segment and the Access segment of the wide area network. The CER provides traffic conditioning, bandwidth management on a granular service class (i.e., voice, video) basis, and quality of service using per hop behaviors. A base/post/camp/station may have a single CER or multiple CERs based on the local architecture. The SUT is an intelligent unified communications network border element. Perimeter routers are components used for scaling unified communications networks from being "Internet Protocol (IP) islands" within a single customer network to becoming an end-to-end IP community.

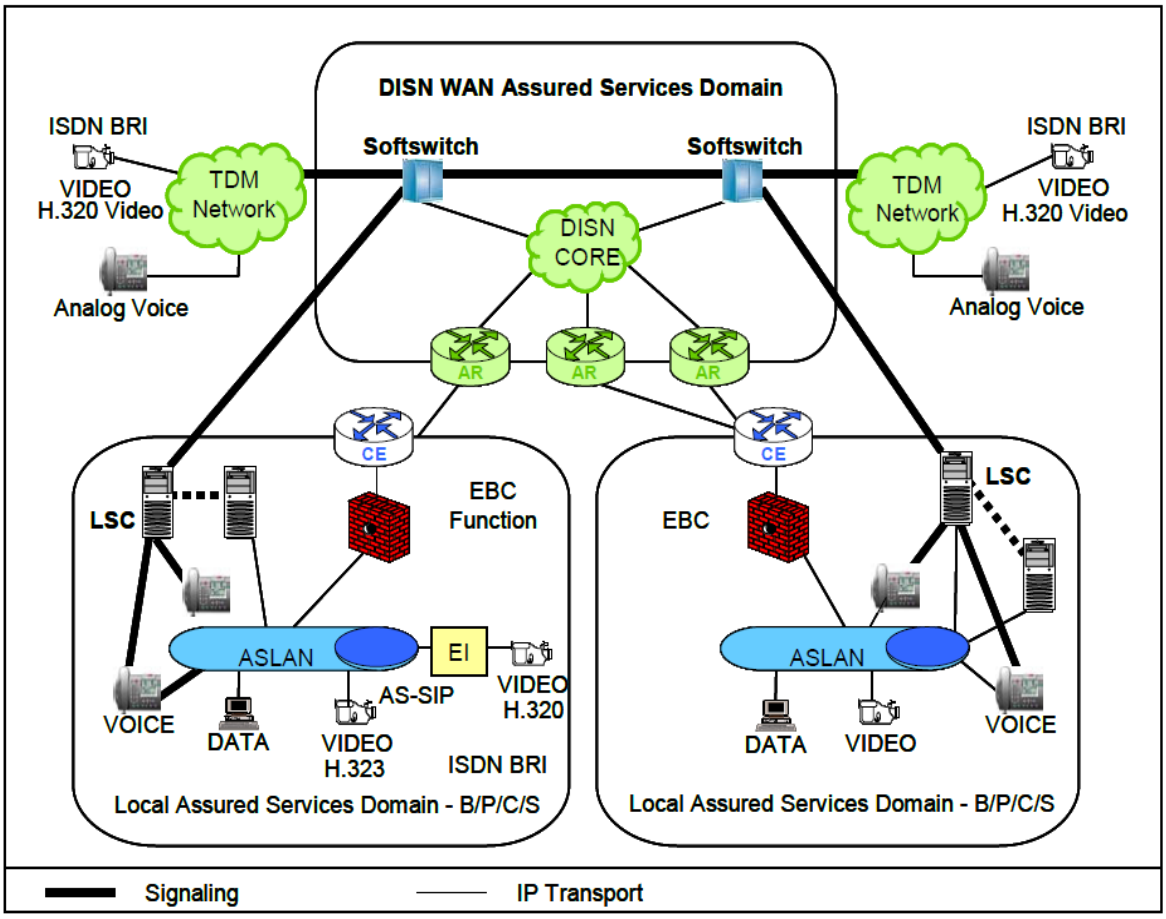
The SUT is a solution that provides a network-to-network demarcation interface for signaling interworking, media interworking, address and port translations, billing, security, Quality-of-Service (QoS), and bandwidth management. The SUT is modular and supports various size installations. The Juniper Networks MX480 was the system tested; however, the Juniper Networks MX240 and MX960 employ the same software and similar hardware as the SUT. The JITC analysis determined these systems to be functionally identical to the SUT for interoperability certification purposes. The SUT is a single chassis that can either be configured with a single Routing Engine (RE)/fabric/power or with redundant RE/fabric/power.

a. SUT High Availability. The high availability solution includes the SUT as a fully redundant chassis (redundant RE, fabric, and power) with no single point of failure.

b. SUT Medium Availability. If a CER meets the High Availability CER requirements, it meets all of the lesser requirements for Medium Availability with and without System Quality Factors (SQF). The medium availability with SQF solution includes the SUT as a fully redundant chassis with no single point of failure. The medium availability without SQF solution does not require redundancy.

c. SUT Low Availability. The low availability solution does not require redundancy.

6. OPERATIONAL ARCHITECTURE. Figure 2-1 depicts the Defense Information System Network (DISN) Unified Capabilities notional operational architecture in which the SUT may be used in.



LEGEND:

ASLAN	Assured Services Local Area Network	EBC	Edge Boundary Controller
AS-SIP	Assured Services – Session Initiation Protocol	IP	Internet Protocol
B/P/C/S	Base / Post / Camp / Station	ISDN	Integrated Services Digital Network
BRI	Basic Rate Interface	LSC	Local Session Controller
CE	Customer Edge (CE Router)	TDM	Time Division Multiplex
DISN	Defense Information System Network	WAN	Wide Area Network

Figure 2-1. DISN Unified Capabilities Notional Operational Architecture

7. INTEROPERABILITY REQUIREMENTS. The interface, Capability Requirements (CR) and Functional Requirements (FR), Information Assurance (IA), and other requirements for CERs are established by Section 5.3.2.14 of Reference (c).

7.1 Interfaces. The SUT uses the interfaces shown in Table 2-1 to connect to the Global Information Grid (GIG) network. This table shows the physical interfaces supported by the SUT and the associated standards.

Table 2-1. CER Interface Requirements

Interface	Critical	UCR Reference	Criteria (See note.)
ASLAN Interfaces			
10Base-X	Yes	5.3.2.4.2 5.3.2.14.9	Support minimum threshold CRs/FRs (1-3) and meet interface criteria for IEEE 802.3i.
100Base-X	Yes	5.3.2.4.2 5.3.2.14.9	Support minimum threshold CRs/FRs (1-3) and meet interface criteria for IEEE802.3u.
1000Base-X	No	5.3.2.4.2 5.3.2.14.9	Support minimum threshold CRs/FRs (1-3) and meet interface criteria for IEEE 802.3z .
WAN Interfaces			
10Base-X	Yes	5.3.2.4.2 5.3.2.14.9	Support minimum threshold CRs/FRs (1-3) and meet interface criteria for IEEE 802.3i.
100Base-X	Yes	5.3.2.4.2 5.3.2.14.9	Support minimum threshold CRs/FRs (1-3) and meet interface criteria for IEEE 802.3u.
1000Base-X	No	5.3.2.4.2 5.3.2.14.9	Support minimum threshold CRs/FRs (1-3) and meet interface criteria for IEEE 802.3z.
DS1	No	5.3.2.4.2 5.3.2.14.9	Support minimum threshold CRs/FRs (1-2) and meet interface criteria for ANSI T1.102
DS3	No	5.3.2.4.2 5.3.2.14.9	Support minimum threshold CRs/FRs (1-2) and meet interface criteria for ITU-T G.703.
E1	No	5.3.2.4.2 5.3.2.14.9	Support minimum threshold CRs/FRs (1-2) and meet interface criteria for ITU-T G.703.
OC-X	No	5.3.2.4.2 5.3.2.14.9	Support minimum threshold CRs/FRs (1-2) and meet interface criteria for ITU-T G.703.
Network Management Interfaces			
10Base-X	Yes	5.3.2.4.4	Support minimum threshold CRs/FRs (4) and meet interface criteria for IEEE 802.3i.
100Base-X	Yes	5.3.2.4.4	Support minimum threshold CRs/FRs (4) and meet interface criteria for IEEE802.3u.
1000Base-X	No	5.3.2.4.4 5.3.2.14.9	Support minimum threshold CRs/FRs (4) and meet interface criteria for IEEE 802.3z.

NOTE: The CR/FR requirements are contained in Table 2-2. The CR/FR numbers represent a roll-up of UCR requirements. Enclosure 3 provides a list of more detailed requirements for CER products.

LEGEND:

802.3i	10 Mbps Base Band over Twisted Pair
802.3u	Standard for carrier sense multiple access with collision detection at 100 Mbps
802.3z	1000BASE-X Gbps Ethernet over Fiber-Optic at 1 Gbps
ANSI	American National Standards Institute
ASLAN	Assured Services Local Area Network
CER	Customer Edge Router
CR	Capability Requirement
FR	Functional Requirement
G.703	Physical/Electrical Characteristics of Hierarchical Digital Interfaces at 1544, 2048, 8448, and 44736 kbit/s Hierarchical Levels
Gbps	Gigabits per second
IEEE	Institute of Electrical and Electronics Engineers
ITU-T	International Telecommunication Union - Telecommunication Standardization Sector
kbit/s	kilobits per second
Mbps	Megabits per second
OC	Optical Carrier
T1.102	Digital Hierarchy - Electrical Interfaces
UCR	Unified Capabilities Requirements
WAN	Wide Area Network

7.2 CR and FR. CERs have required and conditional features and capabilities that are established by Section 5.3.2.14 of the UCR. The SUT does not need to provide non-critical (conditional) requirements. If they are provided, they must function according to the specified requirements. The SUT's features and capabilities and its aggregated requirements in accordance with the UCR CER requirements are listed in Table 2-2. Detailed CR/FR requirements are provided in Table 3-1 of Enclosure 3.

Table 2-2. CER CRs and FRs

CR/FR ID	Capability/ Function	Applicability (See note 1.)	UCR Reference	Remarks
Product Interface Requirements				
1	Internal Interface Requirements	Required	5.3.2.4.1	
	External Physical Interfaces between Network Components	Required	5.3.2.4.2	
	IP Queue Control Capabilities	Required	5.3.2.17.3.4.2. 12 para 1	
	Differentiated Services Code Point	Required	5.3.3.3.2	
	VVoIP Per-Hop Behavior Requirements	Required	5.3.3.3.3	
	Traffic Conditioning Requirements	Required	5.3.3.3.4	
Customer Edge Router Requirements (See note 2.)				
2	Traffic Conditioning	Required	5.3.2.14.1	
	Differentiated Services Support	Required	5.3.2.14.2	
	Per Hop Behavior Support	Required	5.3.2.14.3	
	Interface to the LSC/MFSS for Traffic Conditioning	Conditional	5.3.2.14.4	
	Interface to the LSC/MFSS for Bandwidth Allocation	Conditional	5.3.2.14.5	
	Availability	Required	5.3.2.14.7	
	Packet Transit Time	Required	5.3.2.14.8	
	CER Interfaces and Throughput Support	Required	5.3.2.14.9	
	Assured VVoIP Latency	Required	5.3.3.4	
	Assured VVoIP CE Latency	Required	5.3.3.4.2	
	Assured VVoIP CER-to-CER Latency	Required	5.3.3.4.4	
	Assured VVoIP CER-to-CER Jitter	Required	5.3.3.5.3	
	Assured VVoIP CE Jitter	Required	5.3.3.5.4	
	Assured VVoIP CER-to-CER Packet Loss	Required	5.3.3.6.3	
	Assured VVoIP CE Packet Loss	Required	5.3.3.6.4	
	End-to-End Availability	Required	5.3.3.12.1	
	Availability Design Factors	Required	5.3.3.12.2	
	Product Quality Factors	Required	5.3.3.12.3	

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

CR/FR ID	Capability/ Function	Applicability (See note 1.)	UCR Reference	Status Remarks
Customer Edge Router Requirements (continued) (See note 2.)				
2	Layer 1 – Physical Layer	Required	5.3.3.12.4.1	
	Layer 2 – Data Link Layer	Required	5.3.3.12.4.2	
	Provisioning	Required	5.3.3.13	
	Interchangeability	Required	5.3.3.14	
	Voice Grade of Service	Required	5.3.3.15	
	Survivability	Required	5.3.3.16	This is an E2E engineering requirement and is not testable in a lab environment.[3]
Internet Protocol Version 6 Requirements				
3	IPv6	Required	5.3.3.10	
	Product Requirements	Required	5.3.5.4	
Network Management Requirements				
4	VVoIP NMS Interface Requirements	Required	5.3.2.4.4	
	NM Requirements for CERs	Required	5.3.2.18.1	
	Network Management	Required	5.3.2.14.6	

NOTES:

1. The annotation of 'required' refers to a high-level requirement category. The applicability of each sub-requirement is provided in Enclosure 3.
2. If a CER meets the High Availability CER requirements, it meets all of the lesser requirements for Medium Availability with and without SQF and Low Availability.
3. This is an E2E engineering requirement and, due to variations in network architectures, it could not be accurately tested in a lab environment. To meet E2E requirements, the SUT must be deployed in accordance with its deployment guide and the engineering guidelines provided in UCR Section 5.3.3.

LEGEND:

BGP	Border Gateway Protocol		
CE	Customer Edge	LoC	Letters of Compliance
CER	Customer Edge Router	LSC	Local Session Controller
CR	Capability Requirement	MFSS	Multifunction Softswitch
E2E	End-to-End	NM	Network Management
EBC	Edge Boundary Controller	NMS	Network Management System
FR	Functional Requirement	OSPF	Open Shortest Path First
ID	Identification	SQF	System Quality Factors
IEEE	Institute of Electrical and Electronics Engineers	SUT	System Under Test
IP	Internet Protocol	UCR	Unified Capabilities Requirements
IPv6	Internet Protocol version 6	VVoIP	Voice and Video over Internet Protocol
IS-IS	Intermediate System-Intermediate System		

7.3 Information Assurance (IA). Table 2-3 details the IA requirements applicable to the CER products.

Table 2-3. CER IA Requirements

Requirement	Applicability (See note)	UCR Reference	Criteria
General Requirements	Required	5.4.6.2	Detailed requirements and associated criteria for CER are listed in the IATP, Reference (e) through (g).
Authentication	Required	5.4.6.2.1	
Integrity	Required	5.4.6.2.2	
Confidentiality	Required	5.4.6.2.3	
Non-Repudiation	Required	5.4.6.2.4	
Availability	Required	5.4.6.2.5	

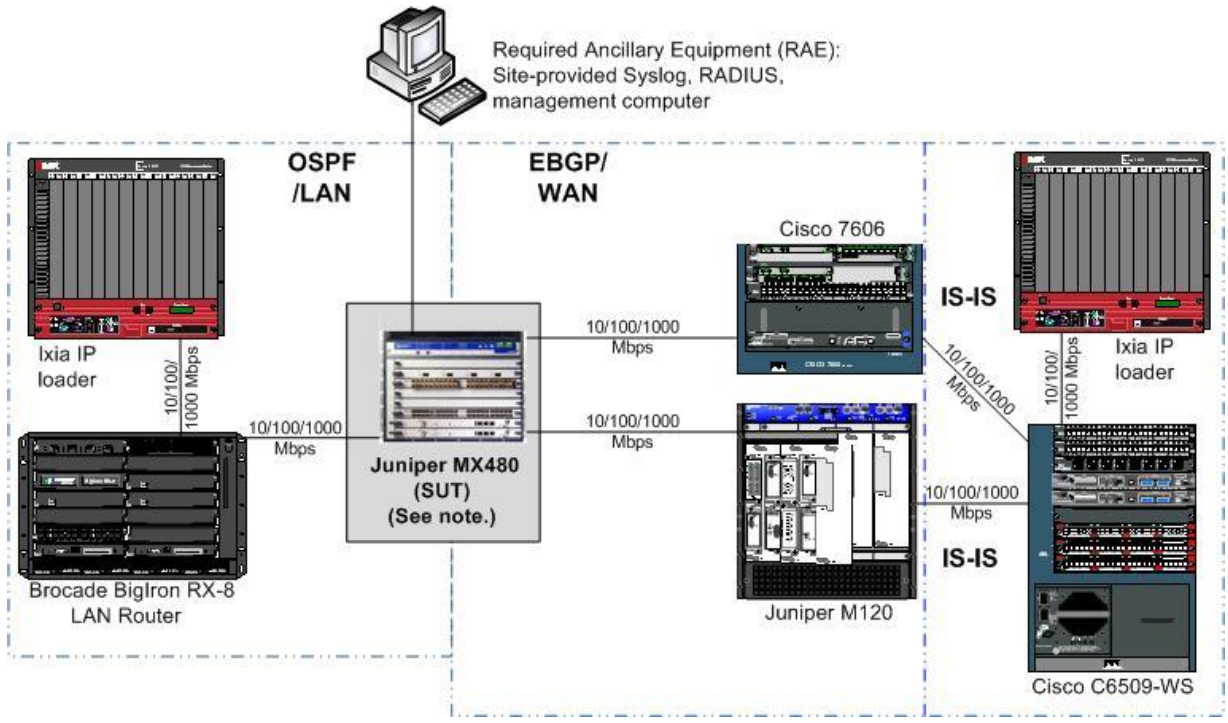
NOTE: The annotation of 'required' refers to a high-level requirement category of IA requirements from the UCR 2008, Change 2, Section 5.4. The detailed IA requirements are included in Reference (e) through (g).

LEGEND:

CER	Customer Edge Router	IATP	IA Test Plan
IA	Information Assurance	UCR	Unified capabilities Requirements

7.4 Other. None

8. TEST NETWORK DESCRIPTION. The SUT was tested at the JITC, Fort Huachuca, Arizona in a manner and configuration similar to that of a notional operational environment. Testing the system's required functions and features was conducted using the test configuration depicted in Figure 2-2. The SUT was tested in a High Availability configuration.



NOTE: This SUT test configuration includes a single Juniper MX480 chassis which met the UCR requirements for high and medium availability with SQF.

LEGEND:

EBGP	Edge Border Gateway Protocol	RADIUS	Remote Authentication Dial In User Service
IP	Internet Protocol	RE	Routing Engine
IS-IS	Intermediate System to Intermediate System	SQF	System Quality Factors
LAN	Local Area Network	SUT	System Under Test
Mbps	Megabits per second	WAN	Wide Area Network
OSPF	Open Shortest Path First		

Figure 2-2. SUT Test Configuration

9. SYSTEM CONFIGURATIONS. Table 2-4 provides the system configurations and hardware and software components tested with the SUT. The SUT was tested in an operationally realistic environment to determine its interoperability capability with associated network devices and network traffic.

Table 2-4. Tested System Configurations

System Name	Software
Cisco C6509-WS	12.2(33)SX12a
Cisco 7606	12.2(17r)S4 Release FC1
Brocade BigIron RX-8	2.7.2a.T145
Juniper Networks M120	Junos 10.0r4.7
	Equipment
Required Ancillary Equipment	Active Directory
	SysLog
	RADIUS
	Site-Provided management PC

Component (See note 1.)	Sub-Component (See note 1.)	Description
Juniper Networks MX480 High Availability with Release Junos 10.0R4.7 (See note 2.)	**MX480-Premium-DC**	Base system with redundant RE-2000, SCB, and power
	MX480-Premium-AC	Base system with redundant RE-2000, SCB, and power
	MX480Base-DC	Chassis, Midplane, RE, 1-SCB, 2 DC PEM
	MX480Base-AC	Chassis, Midplane, RE, 1-SCB, 3 AC PEM
	RE-S-2000	Routing Engine Series 2000
	SCB-MX	System Control Board (Switch Fabric)
	DPCE-X-40GE-TX	40-port 10/100/1000 Ethernet layer 2 and layer 3 capable
	DPCE-R-40GE-SFP	40-port 1 Gigabit Ethernet layer 2 and 3 capable
	DPCE-X-40GE-SFP	40-port 1 Gigabit Ethernet layer 2+
	DPCE-R-Q-40GE-SFP	40-port 1 Gigabit Ethernet layer 2 and 3 capable with enhanced queuing
	DPCE-R-20/2XGE	20-port 1 Gigabit Ethernet SFP and 2-port 10 Gigabit Ethernet XFP layer 2 and layer 3 capable
	RE-S-1300-2048-BB	Routing engine with 1300MHz processor and 2GB memory
	RE-S-2000-4096-UPG-BB	Upgrade from RE-S-1300-2048-BB to RE-2000-4096 on MX960BASE system
	RE-S-1300-2048-R	Routing Engine with 1300MHz processor and 2GB memory, redundant
	RE-S-2000-4096-R	Routing Engine with 2000MHz processor and 4GB memory, redundant
	SCB-MX960-R	Switch Control Board, MX960, redundant
	DPCE-R-20GE-2XGE	20 Port GE, 2x 10GE DPC with L2+L3 features
	DPCE-R-40GE-SFP	40x 1GE Enhanced DPC for MX
	DPCE-R-40GE-TX	40 port 10/100/1000 RJ-45 DPC with L2+L3 features
	DPCE-R-Q-20GE-2XGE	20 Port GE, 2 port 10GE Enhanced Queuing DPC with L2+L3 features
	DPCE-R-Q-20GE-SFP	20x 1GE Enhanced Queuing DPC with L2+L3 features and VLAN-HQoS
	DPCE-R-Q-40GE-SFP	20x 1GE Enhanced Queuing DPC with L2+L3 features and VLAN-HQoS
	SCB-MX960-BB	MX Switch Control Board
Juniper Networks MX240 High Availability with Release Junos 10.0R4.7 (See note 2.)	MX240BASE-AC-HIGH	Chassis, Midplane, 1x RE, 1x SCB, and 1 AC PEM
	MX240BASE-AC-LOW	Chassis, Midplane, 1x RE, 1x SCB, 2x AC PEMs
	MX240BASE-DC	Chassis, Midplane, 1x RE, 1x SCB, and 1 DC PEM
	MX240-DC-CDPC-B	MX240BASE-DC with a DPCE-R-20GE-2XGE
	MX240-Premium-AC-High	Base System with redundant RE-2000, SCB, and power (2x AC PEMs)
	MX240-Premium-AC-Low	Base System with redundant RE-2000, SCB, and power (4x AC PEMs)
	MX240-Premium-DC	Base System with redundant RE-2000, SCB, and power (2x DC PEMs)
Juniper Networks MX960 High Availability with Release Junos 10.0R4.7 (See note 2.)	SCB-MX960-R	Switch Control Board, MX960, redundant
	SCB-MX960-BB	Switch Control Board, MX960
	MX960BASE-Premium-AC-ECM	Base System with redundant RE-2000, SCB , power, Enhanced Cable Manager

NOTES:
1. Components bolded and underlined were tested by JITC. The other components in the family series were not tested; however, they utilize the same software and similar hardware and JITC analysis determined them to be functionally identical for interoperability certification purposes and they are also certified for joint use.
2. The high availability and medium availability with SQF solutions include the SUT as a fully redundant chassis (redundant RE, fabric, and power) with no single point of failure. The Medium Availability without SQF and Low Availability solutions do not require redundancy.

Table 2-4. Tested System Configurations (continued)

LEGEND:

CB	Control Board	POE	Power Over Ethernet
DPCE	Dense Port Concentrator Enhanced	Q	Queuing
FE	Fast Ethernet	R	Routing
GE	Gigabit Ethernet	RE	Routing Engine
GPIM	Gigabit Physical Interface Module	SCB	System Control Board
MS	MultiServices	SFP	Small Form Factor Pluggable
PEM	Power Equipment Module	SQF	System Quality Factors
PIM	Physical Interface Module	SRX	Security Routing Switching
		TX	Twisted Pair

10. TESTING LIMITATIONS. None.

11. INTEROPERABILITY EVALUATION RESULTS. The SUT meets the critical interoperability requirements for a CER in accordance with UCR 2008, Change 2, Section 5.3.2.14, and is certified for joint use with other network infrastructure products listed on the UC APL. Additional discussion regarding specific testing results is located in subsequent paragraphs.

11.1 Interfaces. The interface status of the SUT is provided in Table 2-5.

Table 2-5. SUT Interface Interoperability Status

Interface	Critical	UCR Reference	Threshold CR/FR Requirements (See note 1.)	Status	Remarks
ASLAN Interfaces					
10Base-X	Yes	5.3.2.4.2 5.3.2.14.9	1-3	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3i (10BaseT) interface.
100Base-X	Yes	5.3.2.4.2 5.3.2.14.9	1-3	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3u (100BaseT) interface.
1000Base-X	No	5.3.2.4.2 5.3.2.14.9	1-3	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3ab (1000BaseT) interface.

Table 2-5. SUT Interface Interoperability Status (continued)

Interface	Critical	UCR Reference	Threshold CR/FR Requirements (See note.)	Status	Remarks
WAN Interfaces					
10Base-X	Yes	5.3.2.4.2 5.3.2.14.9	1-3	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3i (10BaseT) interface.
100Base-X	Yes	5.3.2.4.2 5.3.2.14.9	1-3	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3u (100BaseT) interface.
1000Base-X	No	5.3.2.4.2 5.3.2.14.9	1-3	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3ab (1000BaseT) interface.
DS1	No	5.3.2.14.9	1-2	Not Tested	The SUT does not support this interface and it is not required.
DS3	No	5.3.2.14.9	1-2	Not Tested	The SUT does not support this interface and it is not required.
E1	No	5.3.2.14.9	1-2	Not Tested	The SUT does not support this interface and it is not required.
OC-X	No	5.3.2.14.9	1-2	Not Tested	This interface was not tested and is not required.
Network Management Interfaces					
10Base-X	Yes	5.3.2.4.4	4	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3i (10BaseT) interface. This was met by the vendor's LoC.
100Base-X	Yes	5.3.2.4.4	4	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3u (100BaseT) interface. This was met by the vendor's LoC.
1000Base-X	No	5.3.2.4.4 5.3.2.14.9	4	Certified	The SUT met all critical CRs and FRs for the IEEE 802.3ab (1000BaseT) interface. This was met by the vendor's LoC.

NOTE: The annotation of 'required' refers to a high-level requirement category. The applicability of each sub-requirement is provided in Enclosure 3.

LEGEND:

ASLAN	Assured Services Local Area Network	IEEE	Institute of Electrical and Electronics Engineers
CER	Customer Edge Router	LoC	Letters of Compliance
CR	Capability Requirement	OC	Optical Carrier
DS1	Digital Signal Level 1 (1.544 Mbps)	SUT	System Under Test
DS3	Digital Signal Level 3	UCR	Unified Capabilities Requirements
FR	Functional Requirement	WAN	Wide Area Network

11.2 CR and FR. The SUT CR and FR status is depicted in Table 2-6. Detailed CR/FR requirements are provided in Enclosure 3, Table 3-1.

Table 2-6. SUT CRs and FRs Status

CR/FR ID	Capability/ Function	Applicability (See note 1.)	UCR Reference	Status	Remarks
Product Interface Requirements					
1	Internal Interface Requirements	Required	5.3.2.4.1	Met	The SUT met all critical CRs and FRs.
	External Physical Interfaces between Network Components	Required	5.3.2.4.2	Met	The SUT met all critical CRs and FRs.
	IP Queue Control Capabilities	Required	5.3.2.17.3.4. 2.12 para 1	Met	The SUT met all critical CRs and FRs.
	Differentiated Services Code Point	Required	5.3.3.3.2	Met	The SUT met all critical CRs and FRs.
	VVoIP Per-Hop Behavior Requirements	Required	5.3.3.3.3	Met	The SUT met all critical CRs and FRs.
	Traffic Conditioning Requirements	Required	5.3.3.3.4	Met	The SUT met all critical CRs and FRs.
Customer Edge Router Requirements					
2	Traffic Conditioning	Required	5.3.2.14.1	Met	The SUT met all critical CRs and FRs.
	Differentiated Services Support	Required	5.3.2.14.2	Met	The SUT met all critical CRs and FRs.
	Per Hop Behavior Support	Required	5.3.2.14.3	Met	The SUT met all critical CRs and FRs.
	Interface to the LSC/MFSS for Traffic Conditioning	Conditional	5.3.2.14.4	Not Tested	The SUT does not support this feature and it is not required.
	Interface to the LSC/MFSS for Bandwidth Allocation	Conditional	5.3.2.14.5	Not Tested	The SUT does not support this feature and it is not required.
	Availability	Required	5.3.2.14.7	Met	The SUT met all critical CRs and FRs. The SUT met High Availability CER requirements.[2]
	Packet Transit Time	Required	5.3.2.14.8	Met	The SUT met all critical CRs and FRs.
	CER Interfaces and Throughput Support	Required	5.3.2.14.9	Met	The SUT met all critical CRs and FRs.
	Assured VVoIP Latency	Required	5.3.3.4	Met	The SUT met all critical CRs and FRs.[5]
	Assured VVoIP CE Latency	Required	5.3.3.4.2	Met	The SUT met all critical CRs and FRs.[5]
	Assured VVoIP CER-to-CER Latency	Required	5.3.3.4.4	Met	The SUT met all critical CRs and FRs.[5]
	Assured VVoIP CER-to-CER Jitter	Required	5.3.3.5.3	Met	The SUT met all critical CRs and FRs.[5]
	Assured VVoIP CE Jitter	Required	5.3.3.5.4	Met	The SUT met all critical CRs and FRs.[5]
	Assured VVoIP CER-to-CER Packet Loss	Required	5.3.3.6.3	Met	The SUT met all critical CRs and FRs.[5]
	Assured VVoIP CE Packet Loss	Required	5.3.3.6.4	Met	The SUT met all critical CRs and FRs.[5]
	End-to-End Availability	Required	5.3.3.12.1	Met	The SUT met all critical CRs and FRs.[5]
	Availability Design Factors	Required	5.3.3.12.2	Met	The SUT met all critical CRs and FRs.[5]

Table 2-6. SUT CRs and FRs Status (continued)

CR/FR ID	Capability/ Function	Applicability (See note 1.)	UCR Reference	Status	Remarks
Customer Edge Router Requirements (continued)					
2	Product Quality Factors	Required	5.3.3.12.3	Met	The SUT met all critical CRs and FRs.[5]
	Layer 1 – Physical Layer	Required	5.3.3.12.4.1	Met	The SUT met all critical CRs and FRs.[5]
	Layer 2 – Data Link Layer	Required	5.3.3.12.4.2	Met	The SUT met all critical CRs and FRs.[5]
	Provisioning	Required	5.3.3.13	Met	The SUT met all critical CRs and FRs.[5]
	Interchangeability	Required	5.3.3.14	Met	The SUT met this requirement with Static Routing, BGP-4, IS-IS, OSPFv2, OSPFv3, and VRRP.
	Voice Grade of Service	Required	5.3.3.15	Met	The SUT met all critical CRs and FRs.[5]
	Survivability	Required	5.3.3.16	Not Tested	This is an E2E engineering requirement and is not testable in a lab environment.[3]
Internet Protocol Version 6 Requirements					
3	IPv6	Required	5.3.3.10	Met	The SUT met all critical CRs and FRs with the following minor exception: The SUT does not fully support IPv4 functions in IPv6.[4]
	Product Requirements	Required	5.3.5.4	Met	The SUT met all critical CRs and FRs.
Network Management Requirements					
4	VVoIP NMS Interface Requirements	Required	5.3.2.4.4	Met	The SUT met all critical CRs and FRs for the 10/100/1000BaseT interfaces. This was met by vendor's LoC.
	NM Requirements for CERs	Required	5.3.2.18.1	Met	The SUT met all critical CRs and FRs for the 10/100/1000BaseT interfaces. This was met by vendor's LoC.
	Network Management	Required	5.3.2.14.6	Met	The SUT met all critical CRs and FRs for the 10/100/1000BaseT interfaces. This was met by vendor's LoC.

NOTES:

1. The annotation of 'required' refers to a high-level requirement category. The applicability of each sub-requirement is provided in Enclosure 3.
2. If a CER meets the High Availability CER requirements, it meets all of the lesser requirements for Medium Availability with and without SQF and Low Availability.
3. This is an E2E engineering requirement and, due to variations in network architectures, it could not be accurately tested in a lab environment. To meet E2E requirements, the SUT must be deployed in accordance with its deployment guide and the engineering guidelines provided in UCR Section 5.3.3.
4. The UCR 2008, Change 2, Section 5.3.5.4, paragraph 1.4, states that the products which provide a function in IPv4 will have to provide the same function in a seamless manner in IPv6. The vendor is evaluating all devices to determine any deltas between IPv4 and IPv6. This was adjudicated by DISA as having a minor operational impact on 22 April 2011 with the vendor's POA&M stating they will be compliant to no later than 2013 beginning with software release Junos 13.1.
5. This requirement was verified in an operational emulated environment. To meet E2E requirements, the SUT must be deployed in accordance with its deployment guide and the engineering guidelines provided in UCR Section 5.3.3.

Table 2-6. SUT CRs and FRs Status (continued)

LEGEND:

BGP	Border Gateway Protocol	LoC	Letters of Compliance
CE	Customer Edge	LSC	Local Session Controller
CER	Customer Edge Router	MFSS	Multifunction Softswitch
CR	Capability Requirement	NM	Network Management
DISA	Defense Information Systems Agency	NMS	Network Management System
E2E	End-to-End	POA&M	Plan of Actions and Milestones
EBC	Edge Boundary Controller	OSPF	Open Shortest Path First
FR	Functional Requirement	SQF	System Quality Factors
ID	Identification	SUT	System Under Test
IP	Internet Protocol	UCR	Unified Capabilities Requirements
IPv4	Internet Protocol version 4	VRRP	Virtual Router Redundancy Protocol
IPv6	Internet Protocol version 6	VVoIP	Voice and Video over Internet Protocol
IS-IS	Intermediate System-Intermediate System		

a. Product Interface Requirements

(1) Internal Interface. The UCR 2008, Change 2, Section 5.3.2.4.1, states that the CER shall be capable of supporting auto-negotiation even when the Institute of Electrical and Electronics Engineers, Inc. (IEEE) 802.3 standard has it as optional. This applies to 10/100/1000-T Ethernet standards; i.e., IEEE, Ethernet Standard 802.3, 1993; or IEEE, Fast Ethernet Standard 802.3u, 1995; and IEEE, Gigabit Ethernet Standard 802.3ab, 1999. The SUT met the requirements for the 10/100/1000BaseT interfaces through both testing and the vendor's Letters of Compliance (LoC).

(2) External Physical Interfaces between Network Components. The UCR 2008, Change 2, Section 5.3.2.4.2, states the physical interface between an LSC (and its appliances), the EBC, the Assured Services Local Area network (ASLAN) switches/routers, and the CER shall be a 10/100/1000-T Mbps Ethernet interface. Whenever the physical interfaces use 802.3 Ethernet standards, they shall support auto-negotiation even when the IEEE 802.3 standard has it as optional. This applies to 10/100/1000-T Ethernet standards; i.e., IEEE, Ethernet Standard 802.3, 1993; or IEEE, Fast Ethernet Standard 802.3u, 1995; and IEEE, Gigabit Ethernet Standard 802.3ab, 1999. The SUT met the requirements for the 10/100/1000BaseT interfaces through both testing and the vendor's LoC.

(3) Voice and Video over Internet Protocol (VVoIP) Network Management System (NMS) Interface. The UCR 2008, Change 2, Section 5.3.2.4.4, states that the physical VVoIP NMS interface between the DISA VVoIP EMS and the network components (i.e., LSC, MFSS, EBC, CER) is a 10/100-Mbps Ethernet interface. The interface will work in either of the two following modes using auto-negotiation: IEEE, Ethernet Standard 802.3, 1993; or IEEE, Fast Ethernet Standard 802.3u, 1995. The SUT met the requirements for the 10/100 interfaces through vendor's LoC.

b. Customer Edge Router Requirements

(1) Traffic Conditioning. The UCR 2008, Change 2, Section 5.3.2.14.1, states that the product shall be capable of performing traffic conditioning (policing and shaping) on inbound and outbound traffic. Traffic conditioning may involve the dropping of excess packets or the delaying of traffic to ensure conformance with Service Level Agreements (SLAs). The product shall be capable of traffic conditioning the bandwidth associated with a service class. The SUT met the requirement for performing traffic conditioning for inbound and outbound traffic, which was verified through testing. The SUT also met the traffic conditioning of bandwidth with a service class for both Internet Protocol version 4 (IPv4) and Internet Protocol version 6 (IPv6) for all four queues with testing and the vendor's LoC.

(2) Differentiated Services Support. The UCR 2008, Change 2, Section 5.3.2.14.2, states that the SUT shall be capable of supporting Differentiated Services (DiffServ) in accordance with request for comments (RFCs) 2475 and 2474. The SUT met this requirement for both IPv4 and IPv6 with both testing and vendor's LoC.

(3) Per Hop Behavior Support. The UCR 2008, Change 2, Section 5.3.2.14.3, states that the SUT shall be capable of supporting the Per Hop Behaviors (PHBs) as specified in section 5.3.3. The SUT shall be capable of supporting Expedited Forwarding (EF) PHBs in accordance with RFC 3246 and Assured Forwarding (AF) PHB in accordance with RFC 2597. The SUT met these requirements with both testing and vendor's LoC.

(4) Interface to the LSC/MFSS for Traffic Conditioning. The UCR 2008, Change 2, Section 5.3.2.14.4, states that the SUT shall be capable of interfacing to the Local Session Controller (LSC) or Multifunction Softswitch (MFSS) in real time to adjust traffic conditioning parameters based on the updated LSC/MFSS budget. This conditional requirement is not supported by the SUT.

(5) Interface to the LSC/MFSS for Bandwidth Allocation. The UCR 2008, Change 2, Section 5.3.2.14.5, states that the SUT shall be capable of interfacing to the LSC/MFSS in real time to adjust the PHB bandwidth allocations based on the updated LSC/MFSS budgets. This conditional requirement is not supported by the SUT.

(6) Network Management. The UCR 2008, Change 2, Section 5.3.2.14.6, states that the SUT shall support fault, configuration, accounting, performance and security (FCAPS) Network Management functions as defined in the UCR 2008, Change 2, Section 5.3.2.17, Management of Network Appliances. This requirement was met by the vendor's LoC.

(7) Availability. The UCR 2008, Change 2, Section 5.3.2.14.7, depicts the four types of CERs and their associated availability requirements. Locations serving FLASH OVERRIDE/FLASH users and IMMEDIATE/PRIORITY users and ROUTINE

users with PRIORITY and above precedence should install High Availability CERs. The Medium Availability and Low Availability CERS provide cost-effective solutions for locations that serve ROUTINE users. The SUT met the requirements for High Availability CER with the vendor's LoC. A system that meets High Availability requirements meets the lesser availability categories of CER. The SUT is certified with any equivalent Layer 3 ASLAN component listed on the UC APL.

(a) The High Availability CER shall have an availability of 99.999 percent, including scheduled hardware and software maintenance (non-availability of no more than five minutes per year). The High Availability CER shall meet the requirements specified in UCR 2008, Change 2, Section 5.3.2.5.2, Product Quality Factors.

(b) The Medium Availability CER without System Quality Factors (SQF) shall have an availability of 99.99 percent, including scheduled hardware and software maintenance (non-availability of no more than 52.5 minutes per year).

(c) The Medium Availability CER with SQF shall have an availability of 99.99 percent, including scheduled hardware and software maintenance (non-availability of no more than 52.5 minutes per year). The Medium Availability CER with SQF shall meet the requirements specified in UCR 2008, Change 2, Section 5.3.2.5.2, Product Quality Factors.

(d) The Low Availability CER shall have an availability of 99.9 percent, including scheduled hardware and software maintenance (non-availability of no more than 8.76 hours per year).

(8) Packet Transit Time. The UCR 2008, Change 2, Section 5.3.2.14.8, states that the SUT shall be capable of receiving, processing, and transmitting a voice packet within 2 milliseconds (ms) or less in addition to the serialization delay for voice packets as measured from the input interface to output interface under congested conditions (as described in UCR 2008 Change 2, Section 5.3.1.4.1.1, ASLAN Voice Services Latency) to include all internal functions. The SUT measured latency was 0.529 ms for Ethernet, which met the requirement.

(9) CER Interfaces and Throughput Support. The UCR 2008, Change 2, Section 5.3.2.14.9, states that the CER supports an ASLAN-side connection to the Edge Boundary Controller (EBC) and a Wide Area Network (WAN)-side connection to the DISN WAN. The ASLAN-side interface shall be an Ethernet interface (10Base-T or 100Base-T) full duplex. At least one of the WAN-side interfaces shall be an Ethernet interface (10Base-T or 100Base-T) full duplex. The SUT met the requirement through testing and vendor LoC.

(a) The CER may conditionally support a WAN-side access connection interface which can also be TDM based (i.e., DS1, DS3, or E1). These are all full-duplex interfaces, and support two-way simultaneous information exchange at the "line

rate" for the interface (i.e., 1.5 Mbps for DS1, 45 Mbps for DS3, 2.0 Mbps for E1). The SUT does not support WAN-side TDM interfaces. The SUT is certified for the following WAN interfaces: Ethernet 10BaseT, Ethernet 100BaseT, and Ethernet 1000BaseT.

(b) The CER shall support the maximum possible throughput on the WAN-side interface for a full traffic load of all traffic types sent in the ASLAN-to-WAN direction. The SUT met the requirement through testing and the vendor's LoC. The IEEE 802.3i (100Base-T) interface had a measured throughput of 98.5 percent.

(c) The CER shall support the maximum possible throughput on the WAN-side interface in a full-duplex mode, for a full traffic load of UC packets sent simultaneously in both the ASLAN-to-WAN and WAN-to-ASLAN directions. The SUT met this requirement for Ethernet 10BaseT, Ethernet 100BaseT, and Ethernet 1000BaseT within +/- 10 percent maximum possible throughput of each WAN interface through testing and the vendor's LoC.

(d) The CER shall support the maximum possible throughput on the WAN side interface shall be the maximum line rate that the WAN-side interface is provisioned for on the CER. The SUT maximum measured throughput of Ethernet 10BaseT, Ethernet 100BaseT, and Ethernet 1000BaseT WAN interfaces was 98.5 percent. The SUT met the requirement through testing and the vendor's LoC.

c. Remote Network Management Command Requirements. The UCR 2008, Change 2, Section 5.3.2.17.3.4.2.12, paragraph 1, states that setting the queue bandwidth allocations on the CER and its connected port on the Aggregation Router (AR) involves setting the amount (or percentage) of bandwidth allocated to each of the (currently) four queues on the CER and connected Provider Edge (PE) Router. Two bandwidth allocation actions/functions can be performed as follows: Setting the bandwidth allocations by router queue, and setting the drop probabilities with each queue. The SUT met these requirements through testing and the vendor's LoC.

d. Network Management Requirements for CERs. The UCR 2008, Change 2, Section 5.3.2.18, states that the CER shall support the network management requirements for CERs specified below:

(1) The CER shall report faults in accordance with RFCs 1215 and 3418. This requirement was met by the vendor's LoC.

(2) The CER shall present configuration management (CM) in accordance with RFCs 1215 and 3418. This requirement was met by the vendor's LoC.

(3) The CER shall present performance management (PM) in accordance with RFCs 1215 and 3418. This requirement was met by the vendor's LoC.

(4) Conditionally, nonstandard (vendor-specific) CM and PM information shall be presented as private vendor Management Information Base (MIBs), as defined by the applicable RFCs. This conditional requirement was met by the vendor's LoC.

(5) The CER Quality of Service (QoS) queues must be readable and settable by the VVoIP Element Management System (EMS). This requirement was met by the vendor's LoC.

e. General Network Requirements

(1) General Network Requirements. The CER shall support the network requirements in accordance with the UCR 2008, Change 2, Section 5.3.3.3, specified below:

(a) Differentiated Services Code Point. The CER shall support the plain text Differentiated Services Code Points (DSCP) plan, as shown in the UCR 2008, Change 2, Table 5.3.3-1, and the DSCP assignment shall be software configurable for the full range (0-63) to support Deployable deployments that may not use the DSCP plan. This requirement was met by the SUT with testing and the vendor's LoC.

(b) VVoIP Per-Hop Behavior Requirements. The CER shall support the four-queue PHBs, as defined in UCR 2008, Change 2, Table 5.3.3-2. This requirement was met by the SUT with testing and the vendor's LoC.

(c) Traffic Conditioning Requirements. The UCR 2008, Change 2, Section 5.3.3.3.4, states that all CER interfaces toward the CER shall support traffic conditioning on an aggregate granular service class basis on the input interface. The SUT met this requirement through testing.

(i) The CER shall be able to traffic condition using IP addresses, VLAN tags, protocol port numbers, and DSCPs as discriminators, as a minimum. This requirement was met through testing. The SUT met granular service class basis for 10/100/1000 BaseT WAN interfaces within +/- 10 percent of the shaped queue for all tested WAN interfaces.

(ii) All CER interfaces toward the CER shall support traffic conditioning on a granular service class basis on the output interface. This requirement was met through testing. The SUT met granular service class basis within +/- 10 percent of the shaped queue for 10/100/1000 BaseT interfaces.

(2) Assured VVoIP Latency. The UCR 2008, Change 2, Section 5.3.3.4, states that all CERs shall be capable of receiving, processing, and transmitting a voice packet within 2 ms or less in addition to the serialization delay for voice packets as measured from the input interface to output interface under congested conditions. The SUT met all the critical UCR interoperability capability and feature requirements for Customer Edge Router. The JITC measured the individual product latency for the

following WAN interfaces: 0.529 ms for Ethernet. Therefore the following End-to-End (E2E) CER requirements were also met in our operational emulated environment. To meet E2E CER requirements, the SUT must be deployed in accordance with its deployment guide and the engineering guidelines provided in UCR Section 5.3.3.

(a) Assured VVoIP CE latency. The CE Segment supporting VVoIP shall ensure that the one-way latency from the IP handset to the CER within the CE Segment is less than or equal to 35 ms (or less than or equal to 44 ms if the CER is collocated with an AR) for VVoIP sessions as averaged over any 5-minute period. The SUT met the individual product requirement for latency in an emulated E2E environment.

(b) The CE Segment supporting VVoIP shall ensure that the one-way latency from the CER to the IP handset within the CE Segment is less than or equal to 35 ms (or less than or equal to 44 ms if the CER is collocated with an AR) for VVoIP sessions as averaged over any 5-minute period. The SUT met the individual product requirement for latency in an emulated E2E environment.

(c) Assured VVoIP CER to CER Latency. The DISN Network Infrastructure supporting VVoIP shall ensure that the one-way latency from the CER to the CER across the DISN Network Infrastructure for Fixed to Fixed (F-F) nodes does not exceed 150 ms (or 132 ms if the CER is collocated with an AR) for VVoIP as averaged over any 5-minute period. The SUT met the individual product requirement for latency in an emulated E2E environment.

(3) Assured VVoIP Jitter. The UCR 2008, Change 2, Section 5.3.3.5, states that the DISN Network infrastructure products supporting VVoIP shall meet the jitter requirements in the subparagraphs below. The requirements in the sub-paragraphs below depict E2E engineering requirements. To meet E2E CER requirements, the SUT must be deployed in accordance with its deployment guide and the engineering guidelines provided in UCR Section 5.3.3.

(a) Assured VVoIP CER-to-CER Jitter. The CE Segment supporting VVoIP shall ensure that the one-way jitter from the CER to the CER across the DISN Network Infrastructure for F-F does not exceed 14 ms (or 10 ms if the CER is collocated with the AR) for VVoIP sessions during any 5-minute period. The SUT met this requirement in our simulated operational network with a measured E2E jitter of 2.3 ms for Ethernet.

(b) Assured VVoIP CE Jitter. The CE Segment supporting VVoIP shall ensure that the one-way jitter between the handset and CER within the Edge Segment does not exceed 3 ms (or 5 ms if the CER is collocated with an AR) for VVoIP sessions during any 5-minute period. The SUT met the E2E requirement for jitter for Ethernet interfaces.

(4) Assured VVoIP Packet Loss. The UCR 2008, Change 2, Section 5.3.3.6, states that the DISN Network infrastructure products supporting VVoIP shall meet the packet loss requirements in the subparagraphs below. The requirements in the sub-paragraphs below depict E2E engineering requirements. To meet E2E CER requirements, the SUT must be deployed in accordance with its deployment guide and the engineering guidelines provided in UCR Section 5.3.3.

(a) The DISN Network Infrastructure supporting VVoIP shall ensure that the one-way packet loss from the CER across the DISN Network Infrastructure for F-F nodes does not exceed 0.8 percent (or 0.3 percent if the CERs are collocated with the ARs) for VVoIP sessions as averaged over any 5-minute period. The SUT met this requirement in our simulated operational network with a measured E2E packet loss of 0 percent for all interface types.

(b) The CE Segment supporting VVoIP shall ensure that the one-way packet loss between the handset and CER does not exceed 0.05 percent for VVoIP sessions as averaged over any 5-minute period. The SUT met this requirement in our simulated operational network with a measured E2E packet loss of 0 percent for all interface types.

(5) System-Level Quality Factors. The UCR 2008, Change 2, Section 5.3.3.12.1, states that all CERs shall meet the SQFs E2E Availability in the sub-paragraphs below. The requirements in the sub-paragraphs below depict E2E engineering requirements. The SUT met all the critical UCR interoperability capability and feature requirements for Customer Edge Router. The following E2E CER requirements are engineering implementation guidelines to be met when implementing the SUT in the operational network, and cannot be tested in a lab environment.

(a) The availability for the network infrastructure within the F-F from CER to CER shall be 99.96 percent or greater to include scheduled maintenance.

(b) The availability to include scheduled maintenance for the network infrastructure within a CE Segment, which includes ASLAN and EBC shall be 99.998 percent or greater for FO/F users, 99.996 percent or greater for I/P users, and 99.8 percent or greater for other users.

(6) Availability Design Factors. The UCR 2008, Change 2, Section 5.3.3.12.2, states that the CER, as part of E2E network infrastructure, shall meet the following Availability Design Factors:

(a) The E2E network infrastructure supporting VVoIP users with precedence above ROUTINE shall have no single point of failure to include power sources and NM. The SUT met this requirement through testing and the vendor's LoC.

(b) In the event of an E2E network infrastructure component failure in a network supporting VVoIP users with precedence about ROUTINE, all sessions that are

active shall not be disrupted (i.e., loss of existing connection requiring redialing) and a path through the network shall be restored with 5 seconds. The SUT met this requirement through testing and the vendor's LoC. The SUT restoral time was 1 second for 10/100/1000 BaseT which meets the UCR requirement.

(c) No segment of the E2E network infrastructure shall use split cost metric routing for VVoIP traffic. The SUT met this requirement through testing and the vendor's LoC.

(d) All network infrastructure products supporting VVoIP users with precedence above ROUTINE shall have eight hours of backup power. Backup power is provided by the B/P/C/S site where the SUT is deployed. The SUT in a high availability and medium availability with SQF configuration has redundant power supplies to prevent single point of failure and works with backup power.

(7) Product Quality Factors. The UCR 2008, Change 2, Section 5.3.3.12.3, states that the CER, as part of E2E network infrastructure, shall meet the Product Quality Factors in the sub-paragraphs below.

(a) The E2E network infrastructure supporting VVoIP users with precedence above ROUTINE shall support a protocol that allows for dynamic rerouting of IP packets to eliminate any single points of failure. The SUT met this requirement with dynamic routing protocols supported including VRRP, OSPF, OSPFv3, ISIS, and BGP dynamic routing protocols.

(b) All network infrastructure products supporting VVoIP users with precedence above ROUTINE used to meet the reliability requirements shall be capable of handling the entire session processing load in the event that its counterpart product fails. The SUT met this requirement with redundant routing engines and switch fabrics.

(c) All network infrastructure products supporting VVoIP that implement Multiprotocol Label Switching (MPLS) shall have a Fast Re-Route (FRR) capability that restores paths around a local failure (i.e., a failure involving a single router or circuit) within 50 ms. The MPLS protocol is offered by the SUT, however it was not tested and is not a required by the SUT and therefore is not certified for joint use.

(d) Network infrastructure routers shall only enact switchovers based on a reduction in access network throughput or bandwidth with NM troubleshooting procedures, because the routers cannot determine where or what in the access IP connection is the cause of the reduction. This requirement was met through testing and vendor's LoC.

(e) If the network infrastructure supports users with precedence above ROUTINE, then the network infrastructure routers shall provide an availability of 99.999 percent to include scheduled maintenance. The availability requirement of 99.999 for High Availability was met with the vendor's LoC.

(f) If the CER has multiple access connections (i.e., dual homed) and detects an access connection failure, the CER shall switch to the alternate or backup access connection using an automatic process and shall not require operator actions. The SUT met this requirement through testing and the vendor's LoC.

(8) Design and Construction Materials. The CER shall meet design and construction materials requirements of Section 5.3.3.12.4 of UCR 2008 Change 2:

(a) The UCR 2008, Change 2, Section 5.3.3.12.4.1, states that all F-F network infrastructure network connections supporting VVoIP shall have a bandwidth of T1 (1.544 Mbps) or greater. The SUT certified interfaces met this requirement through testing and the vendor's LoC.

(b) The E2E network infrastructure (excluding session originators) supporting VVoIP sessions shall use the media default Maximum Transmission Unit (MTU). The media default MTU for Ethernet is 1500 bytes. The SUT met this requirement through testing and the vendor's LoC.

(c) The E2E network infrastructure supporting VVoIP sessions shall permit packet fragmentation. This is an E2E requirement which can not be measured in a lab environment. IPv6 packet fragmentation is not possible with routers.

(d) All E2E network infrastructure network connections consisting of Ethernet connections that support VVoIP shall be switched full-duplex connections. The SUT met this requirement through testing and the vendor's LoC.

(e) All E2E network infrastructure product Ethernet interfaces shall support auto-negotiation as described in the IEEE 802.3 series of standards. The SUT met this requirement through testing and the vendor's LoC.

(f) All E2E network system network links consisting of Ethernet connections that support VVoIP shall not exceed IEEE recommended distances for Ethernet cabling as shown in the UCR 2008, Change 2, Table 5.3.3-5. The links connected to the SUT were within the recommended distances during testing and met the requirement.

(9) Provisioning. The UCR 2008, Change 2, Section 5.3.3.13, states that the CER shall support the provisioning requirements in the sub-paragraphs below. The SUT met all the critical UCR interoperability capability and feature requirements for Customer Edge Router. This requirement was verified in an operational emulated environment. To meet E2E requirements, the SUT must be deployed in accordance with its deployment guide and the engineering guidelines provided in UCR Section 5.3.3.

(a) The E2E network Infrastructure supporting VVoIP shall assume the use of ITU-T G.711 (20 ms) for calculating bandwidth budgets within the fixed network

even if compressed codecs are used. This requirement was met by the SUT with testing.

(b) The E2E network infrastructure design shall provide, at a minimum a 25 percent increase in network capacity (i.e., throughput and number of sessions) above the current employed network capacity at all tandem switches, MFSs, MFSSs, and critical dual-homed EO switches and LSCs. This requirement was met by the SUT with testing.

(10) Interchangeability. The UCR 2008, Change 2, Section 5.3.3.14, states that the CER shall support the following interchangeability requirements in the sub-paragraphs below. All Edge System routers supporting VVoIP shall support, as a minimum, the following protocols and methods.

(a) Static Routing. Static routing is a manual method for determining the path that traffic should take on egress from a router. The SUT met this requirement through testing and the vendor's LoC.

(b) BGP-4. The BGP-4 is a protocol for exchanging routing information between gateway hosts (each with its own router) in a network of autonomous systems and is described in RFCs 4271 and 1772. The SUT met this requirement through testing and the vendor's LoC.

(c) Intermediate System-to-Intermediate System Protocol (IS-IS). The IS-IS is an OSI protocol by which intermediate systems exchange routing information. This protocol is not intended to be used as the protocol to interface to the ARs. It is a second method for interfacing between the P Router and the AR and typically is associated with dual-homed Edge Segments. The SUT met IS-IS requirement through testing and the vendor's LoC.

(d) The OSPF is an interior gateway protocol used to route IP packets within a routing domain. The OSPF version 2 for IPv4 is described in RFC 2328. Updates to OSPF for IPv6 are described in RFC 5340. The SUT met OSPF v2 and v3 requirements through testing and the vendor's LoC.

(11) Voice Grade of Service (GOS). The UCR 2008, Change 2, Section 5.3.3.15, states that the CER, as part of E2E network infrastructure, shall meet the Product interchangeability requirements in the sub-paragraphs below. The SUT met all the critical UCR interoperability capability and feature requirements for CER. To meet E2E requirements, the SUT must be deployed in accordance with its deployment guide and the engineering guidelines provided in UCR Section 5.3.3.

(a) The E2E network infrastructure shall provide a GOS of P.00 (i.e., zero sessions out of 100 will be "blocked" during the "busy hour") for FLASH and FLASH OVERRIDE voice and video (VVoIP only) sessions. This requirement was verified in an operational emulated environment. To meet E2E requirements, the SUT

must be deployed in accordance with its deployment guide and the engineering guidelines provided in UCR Section 5.3.3.

(b) The E2E network infrastructure shall provide a GOS of P.02 (i.e., two sessions out of 100 will be blocked during the busy hour) and P.01, respectively, during a 100 percent increase above normal precedence usage for PRIORITY and IMMEDIATE voice and video (VVoIP only) sessions at a minimum. This requirement was verified in an operational emulated environment. To meet E2E requirements, the SUT must be deployed in accordance with its deployment guide and the engineering guidelines provided in UCR Section 5.3.3.

(c) The E2E network infrastructure supporting VVoIP shall provide a peacetime theater GOS of P.07 (i.e., seven voice sessions out of 100 will be blocked during the busy hour) or better, and an intertheater GOS of P.09 or better, as measured during normal business hours of the theaters for ROUTINE precedence voice and video (VVoIP only) sessions traversing the network from an EO or LSC EI and/or AS-SIP EI. This requirement was verified in an operational emulated environment. To meet E2E requirements, the SUT must be deployed in accordance with its deployment guide and the engineering guidelines provided in UCR Section 5.3.3.

(12) VVoIP Network Infrastructure Survivability. The UCR 2008, Change 2, Section 5.3.3.16, states that no more than 15 percent of the B/P/C/Ss shall be affected by an outage in the network. This is an engineering implementation guideline to be met when implementing the SUT in the operational network and cannot be tested in a lab environment.

(13) IPv6 Requirements. The UCR 2008, Change 2, Section 5.3.3.10, states that the network infrastructure products supporting VVoIP shall accept, route, and process IPv6 protocol traffic while providing parity to IPv4. The IPv6 requirements are in the UCR 2008, Change 2, Section 5.3.5. The CER met the IPv6 requirements with testing and the vendor's LoC with the following exception. The UCR 2008, Change 2, Section 5.3.5.4, paragraph 1.4, states that the products which provide a function in IPv4 will have to provide the same function in a seamless manner in IPv6 or provide for a suitable substitute using IPv6 technologies, if such technologies are available. The SUT partially complied with this requirement. The vendor is evaluating all devices to determine any deltas between IPv4 and IPv6. This was adjudicated by DISA as having a minor operational impact on 22 April 2011 with the vendor's Plan of Actions and Milestones (POA&M). The vendor POA&M states the SUT will become fully compliant to UCR 2008, Change 2, Section 5.3.5.4 no later than 2013 beginning with software release Junos™ 13.1.

11.3 Information Assurance. Security is tested by DISA-led Information Assurance test teams and published in separate reports, References (e), (f), and (g).

11.4 Other. None

12. TEST AND ANALYSIS REPORT. No detailed test report was developed in accordance with the Program Manager's request. JITC distributes interoperability information via the JITC Electronic Report Distribution (ERD) system, which uses Unclassified-But-Sensitive Internet Protocol Router Network (NIPRNet) e-mail. More comprehensive interoperability status information is available via the JITC System 2-7 Tracking Program (STP). The STP is accessible by .mil/gov users 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 (JIT) at http://jit.fhu.disa.mil (NIPRNet). Information related to DSN testing is on the Telecom Switched Services Interoperability (TSSI) website at http://jitc.fhu.disa.mil/tssi.

SYSTEM FUNCTIONAL AND CAPABILITY REQUIREMENTS

The Customer Edge Routers (CERs) have required and conditional features and capabilities that are established by Section 5.3.2.14 of 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 CERs are listed in Table 3-1. Detailed Information Assurance (IA) requirements are included in Reference (e) and are not listed below.

Table 3-1. CER Capability/Functional Requirements

ID	Requirement	UCR Reference	Required (R) Conditional (C)
1	Internal Interfaces are functions that operate internal to a SUT or UC-approved product. Whenever the physical interfaces use IEEE 802.3 Ethernet standards, they shall support auto-negotiation even when the IEEE 802.3 standard states it is optional. This applies to 10/100/1000-T Ethernet standards; i.e., IEEE Ethernet Standard 802.3, 1993; IEEE Fast Ethernet Standard 802.3u, 1995; and IEEE Gigabit Ethernet Standard 802.3ab, 1999.	5.3.2.4.1	R
2	External physical interfaces between components are functions that cross the demarcation point between SUT and other external network components. The physical interface between an LSC (and its appliances), EBC, ASLAN switches/routers, and the CER shall be a 10/100/1000-T Mbps Ethernet interface. Whenever the physical interfaces use IEEE 802.3 Ethernet standards, they shall support auto-negotiation even when the IEEE 802.3 standard states it is optional. This applies to 10/100/1000-T Ethernet standards; i.e., IEEE Ethernet Standard 802.3, 1993; IEEE Fast Ethernet Standard 802.3u, 1995; and IEEE Gigabit Ethernet Standard 802.3ab, 1999.	5.3.2.4.2	R
3	The physical VVoIP NMS interface between the DISA VVoIP EMS and the network components (i.e., LSC, MFSS, EBC, CER) is a 10/100-Mbps Ethernet interface. The interface will work in either of the two following modes using auto-negotiation: IEEE Ethernet Standard 802.3, 1993 or IEEE Fast Ethernet Standard 802.3u, 1995.	5.3.2.4.4	R
4	The product shall be capable of performing traffic conditioning (policing and shaping) on inbound and outbound traffic.	5.3.2.14.1	R
5	The product shall be capable of traffic conditioning the bandwidth associated with a service class.	5.3.2.14.1	R
6	The product shall be capable of supporting DiffServ in accordance with RFCs 2475 and 2474.	5.3.2.14.2	R
7	The product shall be capable of supporting the PHBs, as specified in UCR 2008, Change 2, Section 5.3.3.	5.3.2.14.3	R
8	The product shall be capable of supporting EF PHBs in accordance with RFC 3246.	5.3.2.14.3	R
9	The product shall be capable of supporting the AF PHB in accordance with RFC 2597.	5.3.2.14.3	R
10	The CER shall be capable of interfacing to the LSC/MFSS in real time to adjust traffic conditioning parameters based on the updated LSC/MFSS budgets.	5.3.2.14.4	C
11	The product shall be capable of interfacing to the LSC/MFSS in real time to adjust the PHB bandwidth allocations based on the updated LSC/MFSS budgets.	5.3.2.14.5	C
12	The product shall support FCAPS Network Management functions as defined in the UCR 2008, Change 2, Section 5.3.2.17.	5.3.2.14.6	R
13	The product shall have an availability of 99.999 percent, including scheduled hardware and software maintenance (non-availability of no more than 5 minutes per year). The product shall meet the requirements specified in the UCR 2008, Change 2, Section 5.3.2.5.2. This applies to a high availability CER.	5.3.2.14.7	R

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

ID	Requirement	UCR Reference	Required (R) Conditional (C)
14	The product shall have an availability of 99.99 percent, including scheduled hardware and software maintenance (non-availability of no more than 52.5 minutes per year). The product does not need to meet the requirements specified in the UCR 2008, Change 2, Section 5.3.2.5.2. This applies to a medium availability CER without SQF.	5.3.2.14.7	R
15	The product shall have an availability of 99.99 percent, including scheduled hardware and software maintenance (non-availability of no more than 52.5 minutes per year). The product shall meet the requirements specified in the UCR 2008, Change 2, Section 5.3.2.5.2. This applies to a medium availability CER with SQF.	5.3.2.14.7	C
16	The product shall have an availability of 99.9 percent, including scheduled hardware and software maintenance (non-availability of no more than 8.76 hours per year). The product does not need to meet the requirements specified in the UCR 2008, Change 2, Section 5.3.2.5.2. This applies to a low availability CER.	5.3.2.14.7	C
17	The CER shall be capable of receiving, processing, and transmitting a voice packet within 2 ms or less in addition to the serialization delay for voice packets as measured from the input interface to output interface under congested conditions.	5.3.2.14.8	R
18	The ASLAN-side interface shall be an Ethernet interface (10Base-T or 100Base-T) full duplex. At least one of the WAN-side interfaces shall be an Ethernet interface (10Base-T or 100Base-T) full duplex.	5.3.2.14.9	R
19	The WAN-side access connection interface can also be TDM based (i.e., DS1, DS3, or E1). These are all full-duplex interfaces, and support two-way simultaneous information exchange at the “line rate” for the interface (i.e., 1.5 Mbps for DS1, 45 Mbps for DS3, 2.0 Mbps for E1).	5.3.2.14.9	C
20	The CER shall support the maximum possible throughput on the WAN-side interface for a full traffic load of all traffic types sent in the ASLAN-to-WAN direction.	5.3.2.14.9	R
21	The CER shall support the maximum possible throughput on the WAN-side interface for a full traffic load of all traffic types sent in the WAN-to-ASLAN direction.	5.3.2.14.9	R
22	The CER shall support the maximum possible throughput on the WAN side interface in a full-duplex mode, for a full traffic load of UC packets sent simultaneously in both the ASLAN-to-WAN and WAN-to-ASLAN directions.	5.3.2.14.9	R
23	The maximum possible throughput on the WAN-side interface shall be the maximum line rate that the WAN-side interface is provisioned for on the CER.	5.3.2.14.9	R
24	Setting the queue bandwidth allocations on the CER and its connected port on the AR involves setting the amount (or percentage) of bandwidth allocated to each of the (currently) four queues on the CER and connected PE Router. Two bandwidth allocation actions/functions can be performed as follows: Setting the bandwidth allocations by router queue and setting the drop probabilities with each queue if the router supports this functionality.	5.3.2.17.3.4.2 .12 para 1	R
25	Faults will be reported IAW RFCs 1215 and 3418.	5.3.2.18.1	R
26	Standard CM information shall be presented IAW RFCs 1213 and 3418.	5.3.2.18.1	R
27	Standard PM information shall be presented IAW RFCs 1213 and 3418.	5.3.2.18.1	R
28	Nonstandard (vendor-specific) CM and PM information shall be presented as private vendor MIBs, as defined by the applicable RFCs.	5.3.2.18.1	C
29	The CER QoS queues must be readable and settable by the VVoIP EMS.	5.3.2.18.1	R
30	The product shall support the plain text DSCP plan, as shown in UCR 2008, Change 2, Table 5.3.3-1, and the DSCP assignment shall be software configurable for the full range (0-63) to support Deployable deployments that may not use the following DSCP plan.	5.3.3.3.2	R
31	The system routers supporting VVoIP shall support the four-queue PHBs as defined in the UCR 2008, Change 2, Table 5.3.3-2.	5.3.3.3.3 para 1	R
32	The system routers supporting VVoIP shall support the eight-queue PHBs as defined in the UCR 2008, Change 2, Table 5.3.3-3.	5.3.3.3.3 para 2	C
33	All CER and/or AR interfaces toward the CER shall support traffic conditioning on an aggregate granular service class basis on the input interface.	5.3.3.3.4 para 1	R

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

ID	Requirement	UCR Reference	Required (R) Conditional (C)
34	The system routers shall be able to traffic condition using IP addresses, VLAN tags, protocol port numbers, and DSCPs as discriminators, as a minimum.	5.3.3.3.4 para 2	R
35	All CERs and/or AR interfaces toward the CER shall support traffic conditioning on a granular service class basis on the output interface.	5.3.3.3.4 para 3	R
36	All routers shall be capable of receiving, processing, and transmitting a voice packet within 2 ms or less in addition to the serialization delay for voice packets as measured from the input interface to output interface under congested conditions, as described in the UCR 2008, Change 2, Section 5.3.1.4.1.1, to include all internal functions.	5.3.3.4	R
The requirements below depict E2E engineering requirements. Due to variations in network architectures, these requirements cannot be accurately tested in a lab environment.			
37	The CE Segment supporting VVoIP shall ensure that the one-way latency from the IP handset to the CER within the CE Segment is less than or equal to 35 ms (or less than or equal to 44 ms if the CER is collocated with an AR) for VVoIP sessions as averaged over any 5-minute period.	5.3.3.4.2 para 1	R
38	The CE Segment supporting VVoIP shall ensure that the one-way latency from the CER to the IP handset within the CE Segment is less than or equal to 35 ms (or less than or equal to 44 ms if the CER is collocated with an AR) for VVoIP sessions as averaged over any 5-minute or period.	5.3.3.4.2 para 2	R
39	The DISN network infrastructure supporting VVoIP shall ensure that the one-way latency from the CER to the CER across the DISN network infrastructure for F-F nodes does not exceed 150 ms (or 132 ms if the CER is collocated with an AR) for VVoIP as averaged over any 5-minute period.	5.3.3.4.4	R
40	The DISN network infrastructure supporting VVoIP shall ensure that the one-way jitter from the CER to the CER across the DISN Network Infrastructure for F-F nodes does not exceed 14 (or 10 ms if the CER is collocated with the AR) for VVoIP sessions during any 5-minute period.	5.3.3.5.3	R
41	The CE Segment supporting VVoIP shall ensure that the one-way jitter between the handset and CER within the Edge Segment does not exceed 3 ms (or 5 ms if the CER is collocated with an AR) for VVoIP sessions during any 5-minute period.	5.3.3.5.4	R
42	The DISN network infrastructure supporting VVoIP shall ensure that the one-way packet loss from the CER to the CER across the DISN network infrastructure for F-F nodes does not exceed 0.8 percent (or 0.3 percent if the CERs are collocated with the ARs) for VVoIP sessions as averaged over any 5-minute period.	5.3.3.6.3	R
43	The CE Segment supporting VVoIP shall ensure that the one-way packet loss between the handset and CER does not exceed 0.05 percent for VVoIP sessions as averaged over any 5-minute period.	5.3.3.6.4	R
44	The network infrastructure products supporting VVoIP shall accept, route, and process IPv6 protocol traffic while providing parity to IPv4.	5.3.3.10	R
45	The availability for the network infrastructure within the F-F from CER to CER shall be 99.96 percent or greater to include scheduled maintenance.	5.3.3.12.1 para 3	R
46	The availability to include scheduled maintenance for the network infrastructure within a Customer Edge Segment, which includes ASLAN and EBC shall be 99.998 percent or greater for FO/F users, 99.996 percent or greater for I/P users, and 99.8 percent or greater for other users.	5.3.3.12.1 para 4	R
47	The E2E network infrastructure supporting VVoIP users with precedence above ROUTINE shall have no single point of failure to include power sources and NM.	5.3.3.12.2 para 1	R
48	In the event of an E2E network infrastructure component failure in a network supporting VVoIP users with precedence above ROUTINE, all sessions that are active shall not be disrupted (i.e., loss of existing connection requiring redialing) and a path through the network shall be restored with 5 seconds.	5.3.3.12.2 para 3	R
49	No segment of the E2E network infrastructure shall use split cost metric routing for VVoIP traffic.	5.3.3.12.2 para 5	R
50	All network infrastructure products supporting VVoIP users with precedence above ROUTINE shall have 8 hours of backup power.	5.3.3.12.2 para 6	R
51	The E2E network infrastructure supporting VVoIP users with precedence above ROUTINE shall support a protocol that allows for dynamic rerouting of IP packets to eliminate any single points of failure.	5.3.3.12.3 para 1	R

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

ID	Requirement	UCR Reference	Required (R) Conditional (C)
52	All network infrastructure products supporting VVoIP users with precedence above ROUTINE used to meet the reliability requirements shall be capable of handling the entire session processing load in the event that its counterpart product fails.	5.3.3.12.3 para 2	R
53	All network infrastructure products supporting VVoIP that implement MPLS shall have a FRR capability that restores paths around a local failure (i.e., a failure involving a single router or circuit) within 50 ms.	5.3.3.12.3 para 3	R
54	Network infrastructure routers shall only enact switchovers based on a reduction in access network throughput or bandwidth with NM troubleshooting procedures, because the routers cannot determine where or what in the access IP connection is the cause of the reduction.	5.3.3.12.3 para 4	R
55	If the network infrastructure supports users with precedence above ROUTINE, then the network infrastructure routers shall provide an availability of 99.999 percent to include scheduled maintenance.	5.3.3.12.3 para 5	C
56	If the CER has at least two separate access connections (i.e., dual homed) and detects an access connection failure, the CER shall switch to the alternate or backup access connection using an automatic process and shall not require operator actions.	5.3.3.12.3 para 7	C
57	All F-F network infrastructure network connections supporting VVoIP shall have a bandwidth of T1 (1.544 Mbps) or greater.	5.3.3.12.4.1	R
58	The E2E network infrastructure (excluding session originators) supporting VVoIP sessions shall use the media default MTU. The media default MTU for Ethernet is 1500 bytes.	5.3.3.12.4.2 para 1	R
59	The E2E network infrastructure supporting VVoIP sessions shall permit packet fragmentation.	5.3.3.12.4.2 para 2	R
60	All E2E network infrastructure network connections consisting of Ethernet connections that support VVoIP shall be switched full-duplex connections.	5.3.3.12.4.2 para 5	R
61	All E2E network infrastructure product Ethernet interfaces shall support auto-negotiation as described in the IEEE 802.3 series of standards.	5.3.3.12.4.2 para 6	R
62	All E2E network system network links consisting of Ethernet connections that support VVoIP shall not exceed IEEE recommended distances for Ethernet cabling as shown in the UCR 2008, Change 2, Table 5.3.3-5.	5.3.3.12.4.2 para 6	R
63	The E2E Network Infrastructure supporting VVoIP shall assume the use of ITU-T G.711 (20 ms) for calculating bandwidth budgets within the fixed network even if compressed codecs are used.	5.3.3.13 para 1	R
64	The E2E network infrastructure design shall provide, at a minimum, a 25 percent increase in network capacity (i.e., throughput and number of sessions) above the current employed network capacity at all tandem switches, MFSs, MFSSs, and critical dual-homed EO switches and LSCs.	5.3.3.13 para 4	R
65	All Edge System routers supporting VVoIP shall support, as a minimum, the following routing protocols and methods: Static Routing, BGP-4, and IS-IS or OSPF.	5.3.3.14 para 1	R
66	The E2E network infrastructure shall provide a GOS of P.00 (i.e., zero sessions out of 100 will be “blocked” during the “busy hour”) for FLASH and FLASH OVERRIDE voice and video (VVoIP only) sessions.	5.3.3.15	R
67	The E2E network infrastructure shall provide a GOS of P.02 (i.e., two sessions out of 100 will be blocked during the busy hour) and P.01, respectively, during a 100 percent increase above normal precedence usage for PRIORITY and IMMEDIATE voice and video (VVoIP only) sessions at a minimum.	5.3.3.15	R
68	The E2E network infrastructure supporting VVoIP shall provide a peacetime theater GOS of P.07 (i.e., seven voice sessions out of 100 will be blocked during the busy hour) or better, and an intertheater GOS of P.09 or better, as measured during normal business hours of the theaters for ROUTINE precedence voice and video (VVoIP only) sessions traversing the network from an EO or LSC EI and/or GEI.	5.3.3.15	R
69	No more than 15 percent of the B/P/C/Ss shall be affected by an outage in the network.	5.3.3.16	R

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

LEGEND:

AF	Assured Forwarding
AR	Aggregation Router
ASLAN	Assured Services Local Area Network
BGP	Border Gateway Protocol
B/P/C/S	Base/Post/Camp/Station
C	Conditional
CER	Customer Edge Router
CM	Configuration Management
DiffServ	Differentiated Services
DISA	Defense Information Systems Agency
DISN	Defense Information System Network
DS1	Digital Signal Level 1 (1.544 Mbps) (2.048 Mbps European)
DS3	Digital Signal Level 3
DSCP	Differentiated Services Code Point
E1	European Basic Multiplex Rate (2.048 Mbps)
E2E	End-to-End
EBC	Edge Boundary Controller
EF	Expedited Forwarding
EI	End Instrument
EO	End Office
F-F	Fixed-to-Fixed
FCAPS	Fault, Configuration, Accounting, Performance, and Security
FO-F	FLASH OVERRIDE/FLASH
FRR	Fast Re-Route
GEI	Generic End Instrument
GOS	Grade of Service
I/P	IMMEDIATE/PRIORITY
IAW	in accordance with
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
IS-IS	Intermediate System-Intermediate System
ITU-T	International Telecommunication Union - Telecommunication Standardization Sector
LSC	Local Session Controller
Mbps	Megabits per second
MFS	Multifunction Switch
MFSS	Multifunction Softswitch
MIB	Management Information Base
MPLS	Multiprotocol Label Switching
ms	millisecond
MTU	Maximum Transmission Unit
NM	Network Management
NMS	Network Management System
OSPF	Open Shortest Path First
para	paragraph
PE	Provider Edge
PHB	Per Hop Behavior
PM	Performance Management
QoS	Quality of Service
R	Required
RFCs	Request for Comments
SQF	System Quality Factors
SUT	System Under Test
T1	Digital Transmission Link Level 1 (1.544 Mbps)
TDM	Time Division Multiplexing
UC	Unified Capabilities
VLAN	Virtual Local Area Network
VVoIP	Voice and Video over Internet Protocol
WAN	Wide Area Network