



DEFENSE INFORMATION SYSTEMS AGENCY

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

30 Jun 11

MEMORANDUM FOR DISTRIBUTION

SUBJECT: Special Interoperability Test Certification of the Cisco Nexus 7000 (N7K) Series Switch with Nexus Operating System (NX OS) 5.1(1a)

References: (a) DoD Directive 4630.05, "Interoperability and Supportability of Information Technology (IT) and National Security Systems (NSS)," 5 May 2005
(b) CJCSI 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 Defense Information Systems Agency (DISA), Joint Interoperability Test Command (JITC), as the responsible organization for interoperability test certification.

2. The Cisco N7K-C7010 Switch Release NX OS 5.1(1a) is hereinafter referred to as the system under test (SUT). The SUT meets all of its critical interoperability requirements and is certified for joint use within the Defense Information System Network (DISN) as an Assured Services Local Area Network (ASLAN) core, distribution, and access switch. The SUT is certified as interoperable for joint use with other ASLAN components listed on the Unified Capabilities (UC) Approved Products List (APL) with the following interfaces: 10GBaseX, 1000BaseSX/LX and 10/100/1000BaseT. The SUT meets the critical interoperability requirements set forth in Reference (c), using test procedures derived from Reference (d). The Cisco N7K-C7018 employs the same software and similar hardware as the SUT. The JITC analysis determined this switch to be functionally identical to the SUT for interoperability certification purposes and it is also certified for joint use.

The SUT is certified to support Defense Switched Network (DSN) Assured Services over Internet Protocol. If a component meets the minimum requirements for deployment in an ASLAN, it also meets the lesser requirements for deployment in a non-ASLAN. Non-ASLANs are "commercial grade" and provide support to Command and Control (C2) (ROUTINE-only calls) (C2R) or non-C2 voice subscribers. The SUT is certified for joint use deployment in a non-ASLAN for C2R and non-C2 traffic. When deployed in a non-ASLAN, the SUT may also be used to receive all levels of precedence but is limited to supporting calls that are originated at ROUTINE precedence only. Non-ASLANs do not meet the availability or redundancy requirements for C2 or Special C2 users and therefore are not authorized to support precedence calls originated above ROUTINE.

Testing of the SUT did not include video services or data applications; however, simulated preferred data, best effort data, and video traffic were generated during testing to determine the

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SUT's ability to prioritize and properly queue voice media and signaling traffic. No other configurations, features, or functions, except those cited within this document, are certified by the JITC. This certification expires upon changes that affect interoperability, but no later than three years from the date of the DISA Certification and Accreditation (CA) provided a positive Recommendation.

3. This finding is based on interoperability testing conducted by the United States Army Information Systems Engineering Command, Technology Integration Center (USAISEC TIC), DISA adjudication of open test discrepancy reports (TDRs), review of the vendor's Letters of Compliance (LoC), and DISA CA Recommendation. Interoperability testing was conducted by the USAISEC TIC, Fort Huachuca, Arizona, from 31 January through 25 February 2011. Review of the vendor's LoC was completed on 10 May 2011. The DISA CA provided a positive recommendation on 3 June 2011 based on the security testing completed by DISA-led IA test teams and published in a separate report, Reference (e).

4. Table 1 provides the SUT's interface status. The SUT's capability and functional requirements are listed in Table 2.

Table 1. SUT Interface Status

Interface	Applicability			CRs/FRs (See note 1.)	Status		
	Co	D	A		Co	D	A
Network Management Interfaces for Core Layer Switches							
EIA/TIA-232 (Serial)	R	R	R	EIA/TIA-232	Met	Met	Met
IEEE 802.3i (10BaseT UTP)	C	C	C	1, 6-15, 18-28, 31, 32-36, 48-53, 58-60, 65, 67-71	Met	Met	Met
IEEE 802.3u (100BaseT UTP)	C	C	C	1, 6-15, 18-28, 31, 32-36, 48-53, 58-60, 65, 67-71	Met	Met	Met
IEEE 802.3ab (1000BaseT UTP)	C	C	C	1, 6-15, 18-28, 31, 32-36, 48-53, 58-60, 65, 67-71	Met	Met	Met
Uplink Interfaces for Core Layer Switches							
IEEE 802.3u (100BaseT UTP)	R	R	C ²	1-15, 16, 18-24, 28-31, 40, 44-53, 55-60, 65-75	Met	Met	Met
IEEE 802.3u (100BaseFX)	C	C	C ²	1-6, 11, 16, 18-24, 28-31, 40-41, 44-53, 55-60, 65-75	Not Supported		
IEEE 802.3ab (1000BaseT UTP)	C	C	C ²	1-16, 18-24, 28-31, 40, 44-53, 55-60, 65-75	Met	Met	Met
IEEE 802.3z (1000BaseX Fiber)	R	R	C ²	1-5, 8-16, 18-24, 28-31, 40, 44-53, 55-60, 65-75	Met	Met	Met
IEEE 802.3ae (10GBaseX)	C	C	C ²	1-5, 8-16, 18, 19, 40-41, 44-53, 55-60, 65-75	Met	Met	Met
Access Interfaces for Core Layer Switches							
IEEE 802.3i (10BaseT UTP)	C	C	C ²	1-15, 18-24, 28-41, 44-54, 58-71	Met	Met	Met
IEEE 802.3u (100BaseT UTP)	R	R	C ²	1-15, 18-24, 28-41, 44-54, 58-71	Met	Met	Met
IEEE 802.3u (100BaseFX)	C	C	C ²	1-6, 11, 18-24, 28-31, 44-54, 58-71	Not Supported		
IEEE 802.3ab (1000BaseT UTP)	C	C	C ²	1-15, 18-24, 28-41, 44-54, 58-71	Met	Met	Met
IEEE 802.3z (1000BaseX Fiber)	R	R	C ²	1-6, 11, 18-24, 28-31, 44-54, 58-71	Met	Met	Met
Generic Requirements for all Interfaces							
Generic Requirements not associated with specific interfaces	R	R	R	30-32, 35, 36, 40, 69-71	Met	Met	Met
DoD IPv6 Profile Requirements	R	R	R	UCR Section 5.3.5.5	Met	Met	Met
Security	R	R	R	UCR Sections 5.3.1.3.8, 5.3.1.5, 5.3.1.6, and 5.4	Met ³	Met ³	Met ³
NOTES:							
1. The SUT's specific capability and functional requirement ID numbers listed in the CRs/FRs column can be cross-referenced in Table 2. These requirements are for the following Cisco switch models which are certified in the Core, Distribution, and Access layers: Switch Cisco N7K-C7010 and Switch N7K-C7018. The devices listed in bold and underlined were tested. The other devices listed are in the same family series as the SUT but were not tested. However, they utilize the same OS software and hardware, and JITC analysis determined this switch to be functionally identical for interoperability certification purposes.							
2. Access layer switches are required to support only one of the following IEEE interfaces: 802.3i, 802.3j, 802.3u, 802.3ab, or 802.3z.							
3. Security testing is accomplished via DISA-led Information Assurance test teams, and the results are published in a separate report, Reference (e).							

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Table 1. SUT Interface Status (continued)

LEGEND:			
802.3ab	1000BaseT Gbps Ethernet over twisted pair at 1 Gbps (125 Mbps)	DISA	Defense Information Systems Agency
802.3ae	10 Gbps Ethernet	EIA	Electronic Industries Alliance
802.3i	10BaseT Mbps over twisted pair	EIA-232	Standard for defining the mechanical and electrical characteristics for connecting Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) data communications devices
802.3u	Standard for carrier sense multiple access with collision detection at 100 Mbps		
802.3z	Gigabit Ethernet Standard	FR	Functional Requirement
10BaseT	10 Mbps (Baseband Operation, Twisted Pair) Ethernet	Gbps	Gigabits per second
100BaseT	100 Mbps (Baseband Operation, Twisted Pair) Ethernet	ID	Identification
100BaseFX	100 Mbps Ethernet over fiber	IEEE	Institute of Electrical and Electronics Engineers
1000BaseFX	1000 Mbps Ethernet over fiber	IPv6	Internet Protocol version 6
1000BaseT	1000 Mbps (Baseband Operation, Twisted Pair) Ethernet	JITC	Joint Interoperability Test Command
10GBaseX	10000 Mbps Ethernet over Category 5 Twisted Pair Copper	Mbps	Megabits per second
A	Access	OS	Operating System
ASLAN	Assured Services Local Area Network	R	Required
C	Conditional	SUT	System Under Test
Co	Core	TIA	Telecommunications Industry Association
CR	Capability Requirement	UCR	Unified Capabilities Requirements
D	Distribution	UTP	Unshielded Twisted Pair

Table 2. SUT Capability and Functional Requirements

ID	Requirement (See note.)	UCR Reference	
1	ASLAN components can have no single point of failure for >96 users for C2 and Special C2 users. Non-ASLAN components can have a single point of failure for C2R and non-C2 users. (R)	5.3.1.2.1, 5.3.1.7.7	
2	Non-blocking of any voice or video traffic at 50% for core and distribution layer switches and 12.5% blocking for access layer switches. (R)	5.3.1.3	
3	Maximum of 1 millisecond (ms) of jitter for voice, 10 ms for video, and preferred data and best effort data NA for all ASLAN components. (R)	5.3.1.3	
4	Maximum of 0.015% packet loss for Voice, 0.05 % for video and preferred data for all ASLAN components. (R)	5.3.1.3	
5	Maximum of 2 ms latency for voice, 10 ms for video, 15 ms for preferred data and best effort data NA for all ASLAN components. (R)	5.3.1.3	
6	100 Mbps IAW IEEE 802.3u and 1 Gbps IAW IEEE 802.3z for core and distribution layer components and only one of the following IEEE interfaces for access layer components: 802.3i, 802.3j, 802.3u, 802.3ab, or 802.3z. (R)	5.3.1.3.1	
7	Force mode and auto-negotiation IAW IEEE 802.3, filtering IAW RFC 1812, and flow control IAW IEEE 802.3x. (R)	5.3.1.3.2	
8	Port Parameter Requirements	Auto-negotiation IAW IEEE 802.3. (R)	5.3.1.3.2
9		Force mode IAW IEEE 802.3. (R)	
10		Flow control IAW IEEE 802.3x. (R)	
11		Filtering IAW RFC 1812. (R)	
12		Link Aggregation IAW IEEE 802.3ad (output/egress ports only). (R)	
13		Spanning Tree Protocol IAW IEEE 802.1D. (R)	
14		Multiple Spanning Tree IAW IEEE 802.1s. (R)	
15	Rapid Reconfiguration of Spanning Tree IAW IEEE 802.1w. (R)		
16	LACP link Failover and Link Aggregation IAW IEEE 802.3ad (uplink ports only) for core and distribution switches. (C)	5.3.1.3.2, 5.3.1.7.7.1	
17	Class of Service Marking: Layer 3 DSCPs IAW RFC 2474 (R); Layer 2 3-bit user priority field of the IEEE 802.1Q 2-byte TCI field. (C)	5.3.1.3.3	
18	VLAN capabilities IAW IEEE 802.1Q. (R)	5.3.1.3.4	

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Table 2. SUT Capability and Functional Requirements (continued)

ID	Requirement (See note.)		UCR Reference
19	Protocols IAW DISR profile (IPv4 and IPv6). IPv4 (R: LAN Switch, Layer 2 Switch): IPv6 (R: LAN Switch, C: Layer 2 Switch). Note: The Layer 2 switch is required to support only RFCs 2460, 5095, and 2464, and it must be able to queue packets based on DSCPs in accordance with (IAW) RFC 2474.		5.3.1.3.5
20	QoS Features	Shall support minimum of 4 queues. (R)	5.3.1.3.6
21		Must be able to assign VLAN tagged packets to a queue. (R)	
22		Support DSCP PHBs per RFCs 2474, 2494, 2597, 2598, and 3246. (R: LAN Switch) Note: Layer 2 switch is required to support RFC 2474 only.	
23		Support a minimum of one of the following: Weighted Fair Queuing (WFQ) IAW RFC 3662, Priority Queuing (PQ) IAW RFC 1046, or Class-Based WFQ IAW RFC 3366. (R)	
24	Must be able to assign a bandwidth or percent of traffic to any queue. (R)		5.3.1.3.7
25	SNMP IAW RFCs 1157, 2206, 3410, 3411, 3412, 3413, and 3414. (R)		
26	SNMP traps IAW RFC 1215. (R)		
27	Network Monitoring	Remote monitoring IAW RFC 1281 and Advanced Encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model IAW RFC 3826. (R)	
28	Product Requirements Summary IAW UCR 2008, Table 5.3.1-5. (R)		5.3.1.3.9
29	E2E Performance (Voice)	No more than 6 ms Latency over any 5-minute period measured under 100% congestion. (R)	5.3.1.4.1
		No more than 3 ms Jitter over any 5-minute period measured under 100% congestion. (R)	
		Packet loss not to exceed .045% engineered (queuing) parameters over any 5-minute period under congestion. (R)	
30	E2E Performance (Video)	No more than 30 ms Latency over any 5-minute period measured under 100% congestion. (R)	5.3.1.4.2
		No more than 30 ms Jitter over any 5-minute period measured under congestion. (R)	
		Packet loss not to exceed 15% engineered (queuing) parameters over any 5-minute period under 100% congestion. (R)	
31	E2E Performance (Data)	No more than 45 ms Latency over any 5-minute period measured under congestion. (R)	5.3.1.4.3
		Packet loss not to exceed engineered (queuing) parameters over any 5-minute period under congestion. (R)	
32	LAN Network Management	Configuration Control for ASLAN and non-ASLAN. (R)	5.3.1.6.1
33		Operational Controls for ASLAN and non-ASLAN. (R)	5.3.1.6.2
34		Performance Monitoring for ASLAN and non-ASLAN. (R)	5.3.1.6.3
35		Alarms for ASLAN and non-ASLAN. (R)	5.3.1.6.4
36		Reporting for ASLAN and non-ASLAN. (R)	5.3.1.6.5
37	Redundancy	Redundant Power Supplies. (required on standalone redundant products)	5.3.1.7.7
38		Chassis Failover. (required on standalone redundant products)	
39		Switch Fabric Failover. (required on standalone redundant products)	
40		Non-LACP Link Failover. (R)	
41		Fiber Blade Failover. (R)	
42		Stack Failover. (C) (required if the stack supports more than 96 users)	
43	CPU (routing engine) blade Failover. (R)		
44	MPLS	MPLS may not add measurable Loss or Jitter to system. (C)	5.3.1.8.4.1
45		MPLS conforms to RFCs in Table 5.3.1-14. (C)	5.3.1.8.4.1
46		MPLS supports L2 and L3 VPNs. (C)	5.3.1.8.4.2.1 /2
47	IPv6 Product Requirements: Dual Stack for IPv4 and IPv6 IAW RFC 4213 if routing functions are supported. (C)		5.3.5.4
48	IPv6 System Requirements	Support IPv6 IAW RFCs 2460 and 5095 if routing functions are supported. (C)	5.3.5.4
49		Support IPv6 packets over Ethernet IAW RFC 2464. (R)	5.3.5.4
50		Support MTU discovery IAW RFC 1981 if routing functions are supported. (R)	5.3.5.4.1
51		Support a minimum MTU of 1280 IAW RFCs 2460 and 5095. (C)	5.3.5.4.1
52		Shall support IPv6 addresses IAW RFC 4291. (R)	5.3.5.4.3
53		Shall support IPv6 scoped addresses IAW RFC 4007. (R)	5.3.5.4.3
54		If routing functions are supported: If DHCP is supported, it must be IAW RFC 3315; if DHCPv6 is supported, it shall be IAW RFC 3313. (C)	5.3.5.4.4
55	IPv6 Router Advertisements	If the system supports routing functions, the system shall inspect valid router advertisements sent by other routers and verify that the routers are advertising consistent information on a link, shall log any inconsistent router advertisements, and shall prefer routers that are reachable over routers whose reachability is suspect or unknown. (C)	5.3.5.4.5.2
56		If the system supports routing functions, the system shall include the MTU value in the router advertisement message for all links IAW RFC 2461 and RFC 4861. (C)	
57		IPv6 Neighbor Discovery: The system shall not set the override flag bit in the neighbor advertisement message for solicited advertisements for anycast addresses or solicited proxy advertisements. (R)	

Table 2. SUT Capability and Functional Requirements (continued)

ID	Requirement (See note.)		UCR Reference
58	IPv6 Neighbor Discovery	If routing functions are supported: Neighbor Discovery IAW RFCs 2461 and 4861. (C)	5.3.5.4.5
59		The system shall not set the override flag bit in the neighbor advertisement message for solicited advertisements for anycast addresses or solicited proxy advertisements. (R)	
60		The system shall set the override flag bit in the neighbor advertisement message to “1” if the message is not an anycast address or a unicast address for which the system is providing proxy service. (R)	
61	IPv6 SLAAC and Manual Address Assignment	If the system supports stateless IP address Auto-configuration, the system shall support IPv6 SLAAC for interfaces supporting UC functions IAW RFC 2462 and RFC 4862. (C)	5.3.5.4.6
62		If the product supports IPv6 SLAAC, the product shall have a configurable parameter that allows the function to be enabled and disabled. (C)	
63		If the product supports IPv6 SLAAC, the product shall have a configurable parameter that allows the “managed address configuration” flag and the “other stateful configuration” flag to always be set and not perform stateless auto-configuration. (C)	
64		If the product supports stateless IP address auto-configurations, including those provided for the commercial market, the DAD shall be disabled IAW RFC 2462 and RFC 4862. (R)	
65		The system shall support manual assignment of IPv6 addresses. (R)	
66	If the system provides routing functions, the system shall default to using the “managed address configuration” flag and the “other stateful” flag set to TRUE in the router advertisements when stateful auto-configuration is implemented. (C)		
67	IPv6 ICMP	The system shall support the ICMPv6 as described in RFC 4443. (R)	5.3.5.4.7
68		The system shall have a configurable rate limiting parameter for rate limiting the forwarding of ICMP messages. (R)	
69		The system shall support the capability to enable or disable the ability of the system to generate a Destination Unreachable message in response to a packet that cannot be delivered to its destination for reasons other than congestion. (R) Required if LS supports routing functions.	
70		The system shall support the enabling or disabling of the ability to send an Echo Reply message in response to an Echo Request message sent to an IPv6 multicast or anycast address. (R)	
71		The system shall validate ICMPv6 messages, using the information contained in the payload, prior to acting on them. (R)	
72	IPv6 Routing Functions	If the system supports routing functions, the system shall support the OSPF for IPv6 as described in RFC 5340. (C)	5.3.5.4.8
73		If the system supports routing functions, the system shall support securing OSPF with Internet Protocol Security (IPSec) as described for other IPSec instances in UCR 2008, Section 5.4. (C)	
74		If the system supports routing functions, the system shall support OSPF for IPv6 as described in RFC 2740, router-to-router integrity using an IP authentication header with HMAC-SHA1-96 with ESP and AH as described in RFC 2404, and shall support OSPFv3 IAW RFC 4552. (C)	
75		If the system supports routing functions, the system shall support the Multicast Listener Discovery (MLD) process as described in RFC 2710 and extended in RFC 3810. (C)	
76	Site Requirements	Engineering Requirements: Physical Media for ASLAN and non-ASLAN (R) (Site requirement)	5.3.1.7.1
77		Battery back-up: two hours for non-ASLAN components and eight hours for ASLAN components. (R) (Site requirement)	5.3.1.7.5
78		Availability of 99.999% (Special C2), 99.997% (C2) for ASLAN (R), and 99.9% (non-C2 and C2R) for non-ASLAN. (R) (Site requirement)	5.3.1.7.6
79	IA Security Requirements	Port-Based Access Control IAW IEEE 802.1x and 802.3x. (R)	5.3.1.3.2
80		Secure methods for network configuration: SSH2 instead of Telnet and support RFCs 4251-4254. Must use HTTPS instead of http and support RFCs 2660 and 2818 for ASLAN and non-ASLAN. (R)	5.3.1.6
81		Security. (R)	5.3.1.3.8
82		Must meet IA requirements IAW UCR 2008 Section 5.4 for ASLAN and non-ASLAN. (R)	5.3.1.5
NOTE: All requirements are for core, distribution, and access layer components unless otherwise specified.			

Table 2. SUT Capability and Functional Requirements (continued)

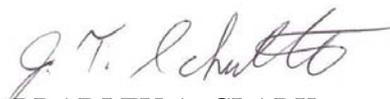
LEGEND:					
ASLAN	Assured Services Local Area Network	HTTPS	Hyper Text Transfer Protocol, Secure	MTU	Maximum Transmission Unit
C	Conditional	IA	Information Assurance	OSPF	Open Shortest Path First
C2	Command and Control	IAW	In Accordance with	OSPFv3	Open Shortest Path First Version 3
C2R	Command and Control ROUTINE only	ICMP	Internet Control Message Protocol	PHB	Per Hop Behavior
CPU	Central Processing Unit	ICMPv6	Internet Control Message Protocol for IPv6	QoS	Quality of Service
DAD	Duplicate Address Detection	ID	Identification	R	Required
DHCP	Dynamic Host Configuration Protocol	IEEE	Institute of Electrical and Electronics Engineers	RFC	Request for Comments
DHCPv6	Dynamic Host Configuration Protocol for IPv6	IPV4	Internet Protocol version 4	SLAAC	Stateless Auto Address Configuration
DISR	Department of Defense Information Technology Standards Registry	IPV6	Internet Protocol version 6	SNMP	Simple Network Management Protocol
DSCP	Differentiated Services Code Point	LACP	Link Aggregation Control Protocol	SSH2	Secure Shell Version 2
E2E	End-to-End	LAN	Local Area Network	SUT	System Under Test
HMAC	Hash-based Message Authentication Code	LS	LAN Switch	TCI	Tag Control Information
HTTP	Hypertext Transfer Protocol	Mbps	Megabits per second	UC	Unified Capabilities
		MPLS	Multiprotocol Label Switching	UCR	Unified Capabilities Requirements
		ms	millisecond	VLAN	Virtual Local Area Network
				VPN	Virtual Private Network

5. In accordance with the Program Manager's request, no detailed test report was developed. 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 <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>. 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 at the Unified Capabilities Certification Office (UCCO), e-mail: ucco@disa.mil.

6. The JITC point of contact is Mr. Edward Mellon, DSN 879-5159, commercial (520) 538-5159, FAX DSN 879-4347, or e-mail to Edward.Mellon@disa.mil. The JITC's mailing address is P.O. Box 12798, Fort Huachuca, AZ 85670-2798. The Tracking Number for the SUT is 1025203.

FOR THE COMMANDER:

2 Enclosures a/s


 for BRADLEY A. CLARK
 Chief
 Battlespace Communications Portfolio

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U.S. Marine Corps MARCORSSYSCOM, SIAT, MJI Division I

DOT&E, Net-Centric Systems and Naval Warfare

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Defense Intelligence Agency

National Security Agency, DT

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U.S. Joint Forces Command, Net-Centric Integration, Communication, and Capabilities Division, J68

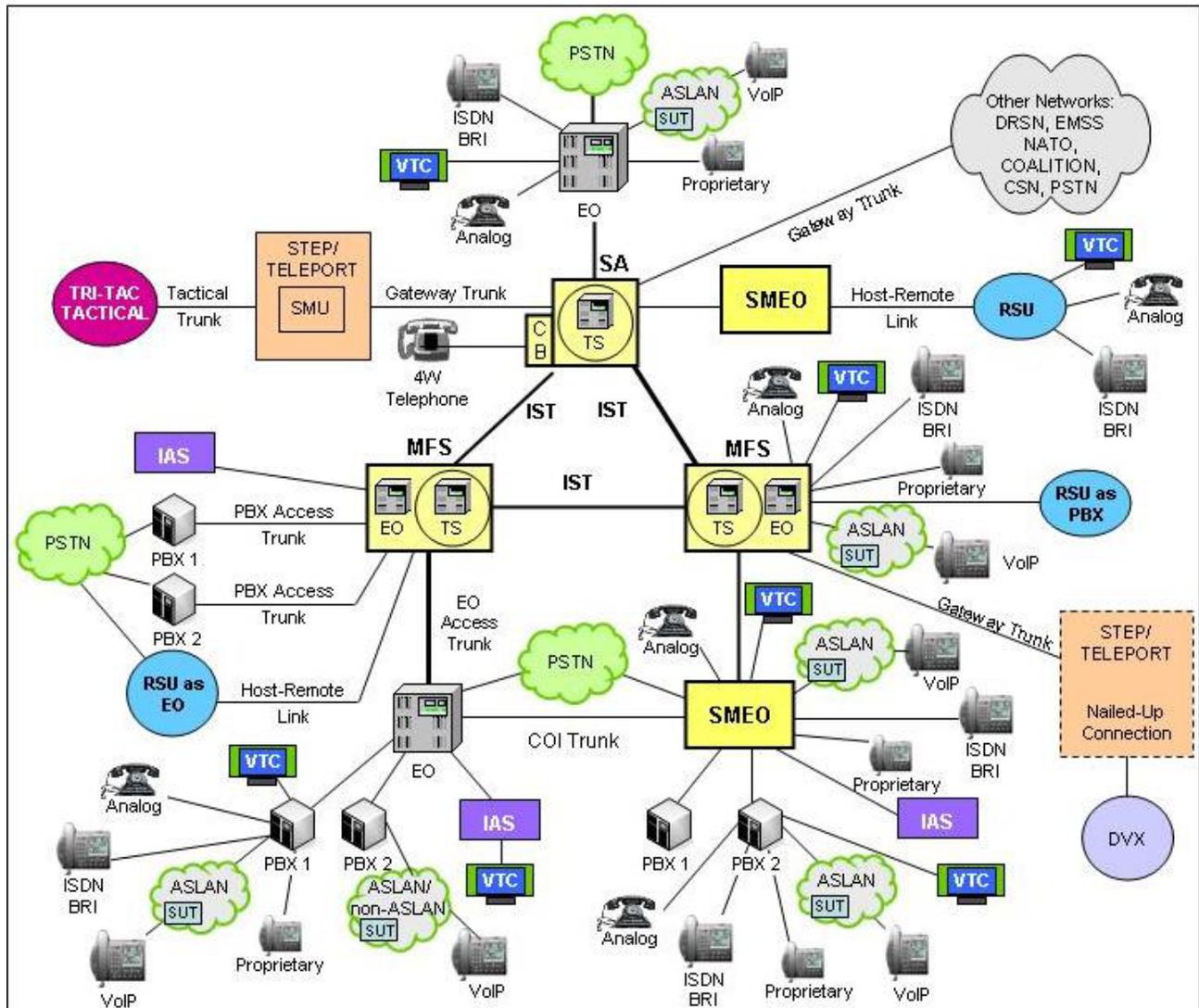
Defense Information Systems Agency, GS23

ADDITIONAL REFERENCES

- (c) Office of the Assistant Secretary of Defense, "Department of Defense Unified Capabilities Requirements 2008 Change 2," 31 Dec 2010
- (d) Joint Interoperability Test Command, "Defense Switched Network Generic Switch Test Plan (GSTP), Change 2," 2 October 2006
- (e) Joint Interoperability Test Command, "Information Assurance (IA) Assessment of Cisco Nexus N7K-C7010 (Tracking Number 1025203)," 3 June 2011

CERTIFICATION TESTING SUMMARY

- 1. SYSTEM TITLE.** Cisco Nexus 7000 (N7K) Series Switch with Nexus Operating System (NX OS) 5.1(1a).
- 2. PROPONENT.** Headquarters, United States Army Information Systems Engineering Command (HQ USAISEC).
- 3. PROGRAM MANAGER.** Mr. Jordan Silk, ELIE-ISE-TI, Building 53302 Arizona Street, Fort Huachuca, AZ 85613-5300; e-mail: Jordan.Silk @us.army.mil.
- 4. TESTER.** USAISEC Technology Integration Center (TIC), Fort Huachuca, Arizona.
- 5. SYSTEM UNDER TEST DESCRIPTION.** The SUT is used to transport voice signaling and media as part of an overall Voice over Internet Protocol (VoIP) system. The SUT provides availability, security, and Quality of Service (QoS) to meet the operational requirements of the network and Assured Services for the Warfighter. The SUT is certified as a core, distribution, and access switch and is interoperable for joint use with other Assured Services Local Area Network (ASLAN) components listed on the Unified Capabilities Approved Products List (UC APL) with the following interfaces: 10GBaseX, 1000 Base SX/LX and 10/100/1000 BaseT. The Nexus N7K-C7010 was the system tested; however, the Cisco N7K-C7018 employs the same software and similar hardware as the SUT. The JITC analysis determined this switch to be functionally identical for interoperability certification purposes.
- 6. OPERATIONAL ARCHITECTURE.** The Defense Switched Network (DSN) architecture is a two-level network hierarchy consisting of DSN backbone switches and Service/Agency installation switches. Service/Agency installation switches have been authorized to extend voice services over Internet Protocol (IP) infrastructures. The Unified Capabilities Requirements (UCR) operational DSN Architecture is depicted in Figure 2-1, which illustrates the relationship of the ASLAN and non-ASLAN to the DSN switch types.



LEGEND:

4W 4-Wire
 ASLAN Assured Services Local Area Network
 BRI Basic Rate Interface
 CB Channel Bank
 COI Community of Interest
 CSN Canadian Switch Network
 DRSN Defense Red Switch Network
 DSN Defense Switched Network
 DVX Deployable Voice Exchange
 EMSS Enhanced Mobile Satellite System
 EO End Office
 IAS Integrated Access Switch
 IP Internet Protocol
 ISDN Integrated Services Digital Network
 IST Interswitch Trunk
 MFS Multifunction Switch

NATO North Atlantic Treaty Organization
 PBX Private Branch Exchange
 PBX 1 Private Branch Exchange 1
 PBX 2 Private Branch Exchange 2
 PC Personal Computer
 PSTN Public Switched Telephone Network
 RSU Remote Switching Unit
 SMEO Small End Office
 SMU Switched Multiplex Unit
 STEP Standardized Tactical Entry Point
 TDM/P Time Division Multiplex/Packetized
 Tri-Tac Tri-Service Tactical Communications Program
 TS Tandem Switch
 VoIP Voice over Internet Protocol
 VTC Video Teleconferencing
 SUT System Under Test

Figure 2-1. DSN Architecture

7. REQUIRED SYSTEM INTERFACES. The SUT capability and functional requirements are listed in Table 2-1. These requirements are derived from the UCR 2008, Change 2, and have been verified by means of JITC testing and a review of the vendor's Letters of Compliance (LoC).

Table 2-1. SUT Capability and Functional Requirements

ID	Requirement (See note.)		UCR Reference
1	ASLAN components can have no single point of failure for >96 users for C2 and Special C2 users. Non-ASLAN components can have a single point of failure for C2R and non-C2 users. (R)		5.3.1.2.1, 5.3.1.7.7
2	Non-blocking of any voice or video traffic at 50% for core and distribution layer switches and 12.5% blocking for access layer switches. (R)		5.3.1.3
3	Maximum of 1 ms of jitter for voice, 10 ms for video, and preferred data and best effort data NA for all ASLAN components. (R)		5.3.1.3
4	Maximum of 0.015% packet loss for voice, 0.05 % for video and preferred data for all ASLAN components. (R)		5.3.1.3
5	Maximum of 2 ms latency for voice, 10 ms for video, 15 ms for preferred data, and best effort data NA for all ASLAN components. (R)		5.3.1.3
6	100 Mbps IAW IEEE 802.3u and 1 Gbps IAW IEEE 802.3z for core and distribution layer components and only one of the following IEEE interfaces for access layer components: 802.3i, 802.3j, 802.3u, 802.3ab or 802.3z. (R)		5.3.1.3.1
7	Force mode and auto-negotiation IAW IEEE 802.3, filtering IAW RFC 1812, and flow control IAW IEEE 802.3x. (R)		5.3.1.3.2
8	Port Parameter Requirements	Auto-negotiation IAW IEEE 802.3. (R)	5.3.1.3.2
9		Force mode IAW IEEE 802.3. (R)	
10		Flow control IAW IEEE 802.3x. (R)	
11		Filtering IAW RFC 1812. (R)	
12		Link Aggregation IAW IEEE 802.3ad (output/egress ports only). (R)	
13		Spanning Tree Protocol IAW IEEE 802.1D. (R)	
14		Multiple Spanning Tree IAW IEEE 802.1s. (R)	
15		Rapid Reconfiguration of Spanning Tree IAW IEEE 802.1w. (R)	
16	LACP link Failover and Link Aggregation IAW IEEE 802.3ad (uplink ports only) for core and distribution switches. (C)		5.3.1.3.2, 5.3.1.7.7.1
17	Class of Service Marking: Layer 3 DSCPs IAW RFC 2474 (R); Layer 2 3-bit user priority field of the IEEE 802.1Q 2-byte TCI field. (C)		5.3.1.3.3
18	VLAN Capabilities IAW IEEE 802.1Q. (R)		5.3.1.3.4
19	Protocols IAW DISR profile (IPv4 and IPv6). IPv4 (R: LAN Switch, Layer 2 Switch); IPv6 (R: LAN Switch, C: Layer 2 Switch). Note: The Layer 2 switch is required to support only RFCs 2460, 5095, and 2464, and it must be able to queue packets based on DSCPs in accordance with (IAW) RFC 2474.		5.3.1.3.5
20	QoS Features	Shall support minimum of 4 queues. (R)	5.3.1.3.6
21		Must be able to assign VLAN tagged packets to a queue. (R)	
22		Support DSCP PHBs per RFCs 2474, 2494, 2597, 2598, and 3246. (R: LAN Switch). Note: The Layer 2 switch is required to support RFC 2474 only.	
23		Support a minimum of one of the following: Weighted Fair Queuing (WFQ) IAW RFC 3662, Priority Queuing (PQ) IAW RFC 1046, or Class-Based WFQ IAW RFC 3366. (R)	
24		Must be able to assign a bandwidth or percent of traffic to any queue. (R)	
25	Network Monitoring	SNMP IAW RFCs 1157, 2206, 3410, 3411, 3412, 3413, and 3414. (R)	5.3.1.3.7
26		SNMP traps IAW RFC 1215. (R)	
27		Remote monitoring IAW RFC 1281 and Advanced Encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model IAW RFC 3826. (R)	
28	Product Requirements Summary IAW UCR 2008, Table 5.3.1-5. (R)		5.3.1.3.9
29	E2E Performance (Voice)	No more than 6 ms Latency over any 5-minute period measured under 100% congestion. (R)	5.3.1.4.1
		No more than 3 ms Jitter over any 5-minute period measured under 100% congestion. (R)	
		Packet loss not to exceed 0.045% engineered (queuing) parameters over any 5-minute period under congestion. (R)	
30	E2E Performance (Video)	No more than 30 ms Latency over any 5-minute period measured under 100% congestion. (R)	5.3.1.4.2
		No more than 30 ms Jitter over any 5-minute period measured under congestion. (R)	
		Packet loss not to exceed 15% engineered (queuing) parameters over any 5-minute period under 100% congestion. (R)	

Table 2-1. SUT Capability and Functional Requirements (continued)

ID	Requirement (See note.)		UCR Reference
31	E2E Performance (Data)	No more than 45 ms Latency over any 5-minute period measured under congestion. (R) Packet loss not to exceed engineered (queuing) parameters over any 5-minute period under congestion. (R)	5.3.1.4.3
32	LAN Network Management	Configuration Control for ASLAN and non-ASLAN. (R)	5.3.1.6.1
33		Operational Controls for ASLAN and non-ASLAN. (R)	5.3.1.6.2
34		Performance Monitoring for ASLAN and non-ASLAN. (R)	5.3.1.6.3
35		Alarms for ASLAN and non-ASLAN. (R)	5.3.1.6.4
36		Reporting for ASLAN and non-ASLAN. (R)	5.3.1.6.5
37	Redundancy	Redundant Power Supplies. (Required on standalone redundant products)	5.3.1.7.7
38		Chassis Failover. (Required on standalone redundant products)	
39		Switch Fabric Failover. (Required on standalone redundant products)	
40		Non-LACP Link Failover. (R)	
41		Fiber Blade Failover. (R)	
42		Stack Failover. (C) (Required if the stack supports more than 96 users)	
43		CPU (routing engine) blade Failover. (R)	
44	MPLS	MPLS may not add measurable Loss or Jitter to system. (C)	5.3.1.8.4.1
45		MPLS conforms to RFCs in Table 5.3.1-14. (C)	5.3.1.8.4.1
46		MPLS supports L2 and L3 VPNs. (C)	5.3.1.8.4.2.1/2
47	IPv6 Product Requirements: Dual Stack for IPv4 and IPv6 IAW RFC 4213 if routing functions are supported. (C)		5.3.5.4
48	IPv6 System Requirements	Support IPv6 IAW RFCs 2460 and 5095 if routing functions are supported. (C)	5.3.5.4
49		Support IPv6 packets over Ethernet IAW RFC 2464. (R)	5.3.5.4
50		Support MTU discovery IAW RFC 1981 if routing functions are supported. (R)	5.3.5.4.1
51		Support a minimum MTU of 1280 IAW RFCs 2460 and 5095. (C)	5.3.5.4.1
52		Shall support IPv6 addresses IAW RFC 4291. (R)	5.3.5.4.3
53		Shall support IPv6 scoped addresses IAW RFC 4007. (R)	5.3.5.4.3
54		If routing functions are supported: If DHCP is supported, it must be IAW RFC 3315; if DHCPv6 is supported, it shall be IAW RFC 3313. (C)	5.3.5.4.4
55	IPv6 Router Advertisements	If the system supports routing functions, the system shall inspect valid router advertisements sent by other routers and verify that the routers are advertising consistent information on a link and shall log any inconsistent router advertisements, and shall prefer routers that are reachable over routers whose reachability is suspect or unknown. (C).	5.3.5.4.5.2
56		If the system supports routing functions, the system shall include the MTU value in the router advertisement message for all links IAW RFC 2461 and RFC 4861. (C)	
57		IPv6 Neighbor Discovery: The system shall not set the override flag bit in the neighbor advertisement message for solicited advertisements for anycast addresses or solicited proxy advertisements. (R)	
58	IPv6 Neighbor Discovery	If routing functions are supported, Neighbor Discovery IAW RFCs 2461 and 4861. (C)	5.3.5.4.5
59		The system shall not set the override flag bit in the neighbor advertisement message for solicited advertisements for anycast addresses or solicited proxy advertisements. (R)	
60		The system shall set the override flag bit in the neighbor advertisement message to "1" if the message is not an anycast address or a unicast address for which the system is providing proxy service. (R)	
61	IPv6 SLAAC and Manual Address Assignment	If the system supports stateless IP address Auto-configuration, the system shall support IPv6 SLAAC for interfaces supporting UC functions IAW RFC 2462 and RFC 4862. (C)	5.3.5.4.6
62		If the product supports IPv6 SLAAC, the product shall have a configurable parameter that allows the function to be enabled and disabled. (C)	
63		If the product supports IPv6 SLAAC, the product shall have a configurable parameter that allows the "managed address configuration" flag and the "other stateful configuration" flag to always be set and not perform stateless auto-configuration. (C)	
64		If the product supports stateless IP address auto-configurations, including those provided for the commercial market, the DAD shall be disabled IAW RFC 2462 and RFC 4862. (R)	
65		The system shall support manual assignment of IPv6 addresses. (R)	
66		If the system provides routing functions, the system shall default to using the "managed address configuration" flag and the "other stateful" flag set to TRUE in the router advertisements when stateful auto-configuration is implemented. (C)	

Table 2-1. SUT Capability and Functional Requirements (continued)

ID	Requirement (See note.)		UCR Reference
67	IPv6 ICMP	The system shall support the ICMPv6 as described in RFC 4443. (R)	5.3.5.4.7
68		The system shall have a configurable rate limiting parameter for rate limiting the forwarding of ICMP messages. (R)	
69		The system shall support the capability to enable or disable the ability of the system to generate a Destination Unreachable message in response to a packet that cannot be delivered to its destination for reasons other than congestion. (R) (Required if LS supports routing functions)	
70		The system shall support the enabling or disabling of the ability to send an Echo Reply message in response to an Echo Request message sent to an IPv6 multicast or anycast address. (R)	
71		The system shall validate ICMPv6 messages using the information contained in the payload prior to acting on them. (R)	
72	IPv6 Routing Functions	If the system supports routing functions, the system shall support the OSPF for IPv6 as described in RFC 5340. (C)	5.3.5.4.8
73		If the system supports routing functions, the system shall support securing OSPF with Internet Protocol Security (IPSec) as described for other IPSec instances in UCR 2008, Section 5.4. (C)	
74		If the system supports routing functions, the system shall support OSPF for IPv6 as described in RFC 2740, router-to-router integrity using an IP authentication header with HMAC-SHA1-96 with ESP and AH as described in RFC 2404, and OSPFv3 IAW RFC 4552. (C)	
75		If the system supports routing functions, the system shall support the Multicast Listener Discovery (MLD) process as described in RFC 2710 and extended in RFC 3810. (C)	
76	Site Requirements	Engineering Requirements: Physical Media for ASLAN and non-ASLAN. (R) (Site requirement)	5.3.1.7.1
77		Battery back-up: two hours for non-ASLAN components and eight hours for ASLAN components. (R) (Site requirement)	5.3.1.7.5
78		Availability of 99.999% (Special C2), 99.997% (C2) for ASLAN (R), and 99.9% (non-C2 and C2R) for non-ASLAN. (R) (Site requirement)	5.3.1.7.6
79	IA Security requirements	Port-Based access Control IAW IEEE 802.1x and 802.3x. (R)	5.3.1.3.2
80		Secure methods for network configuration: SSH2 instead of Telnet and support RFCs 4251-4254. Must use HTTPS instead of http and support RFCs 2660 and 2818 for ASLAN and non-ASLAN. (R)	5.3.1.6
81		Security. (R)	5.3.1.3.8
82		Must meet IA requirements IAW UCR 2008, Section 5.4 for ASLAN and non-ASLAN. (R)	5.3.1.5

NOTE: All requirements are for core, distribution, and access layer components unless otherwise specified.

LEGEND:

ASLAN	Assured Services Local Area Network	HTTPS	Hyper Text Transfer Protocol, Secure	MTU	Maximum Transmission Unit
C	Conditional	IA	Information Assurance	NA	Not Applicable
C2	Command and Control ROUTINE only	IAW	In accordance with	OSPF	Open Shortest Path First
C2R	Command and Control ROUTINE only	ICMP	Internet Control Message Protocol	OSPFv3	Open Shortest Path First Version 3
CPU	Central Processing Unit	ICMPv6	Internet Control Message Protocol for IPv6	PHB	Per Hop Behavior
DAD	Duplicate Address Detection	ID	Identification	QoS	Quality of Service
DHCP	Dynamic Host Configuration Protocol	IEEE	Institute of Electrical and Electronics Engineers	R	Required
DHCPv6	Dynamic Host Configuration Protocol for IPv6	IPv4	Internet Protocol version 4	RFC	Request for Comments
DISR	Department of Defense Information Technology Standards Registry	IPv6	Internet Protocol version 6	SLAAC	Stateless Auto Address Configuration
DSCP	Differentiated Services Code Point	LACP	Link Aggregation Control Protocol	SNMP	Simple Network Management Protocol
E2E	End-to-End	LAN	Local Area Network	SSH2	Secure Shell Version 2
HMAC	Hash-based Message Authentication Code	LS	LAN Switch	SUT	System Under Test
HTTP	Hypertext Transfer Protocol	Mbps	Megabits per second	TCI	Tag Control Information
		MPLS	Multiprotocol Label Switching	UC	Unified Capabilities
		ms	millisecond	UCR	Unified Capabilities Requirements
				VLAN	Virtual Local Area Network
				VPN	Virtual Private Network

8. TEST NETWORK DESCRIPTION. The SUT was tested at the USAISEC TIC, a DoD Component Test Lab, in a manner and configuration similar to those of the DSN's operational environment. A notional diagram of the SUT within an ASLAN VoIP architecture is depicted in Figure 2-2, and the notional non-ASLAN VoIP architecture is depicted in Figure 2-3. The notional ASLAN and non-ASLAN combined VoIP architecture is depicted in Figure 2-4. The ASLAN test configuration used to test the SUT in a homogeneous network is depicted in Figure 2-5, and the heterogeneous test network configurations are depicted in Figures 2-6 through 2-8.

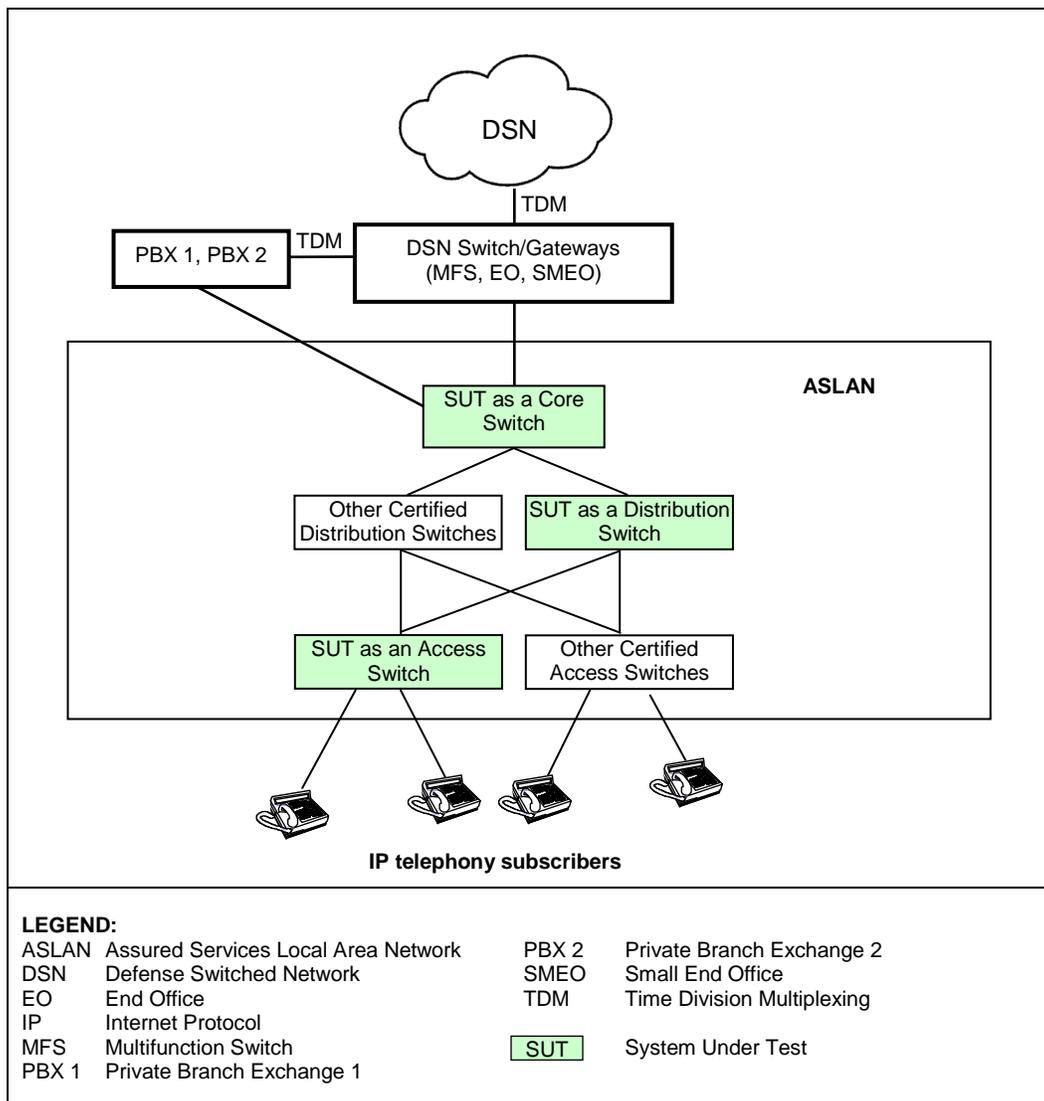


Figure 2-2. SUT Notional ASLAN VoIP Architecture

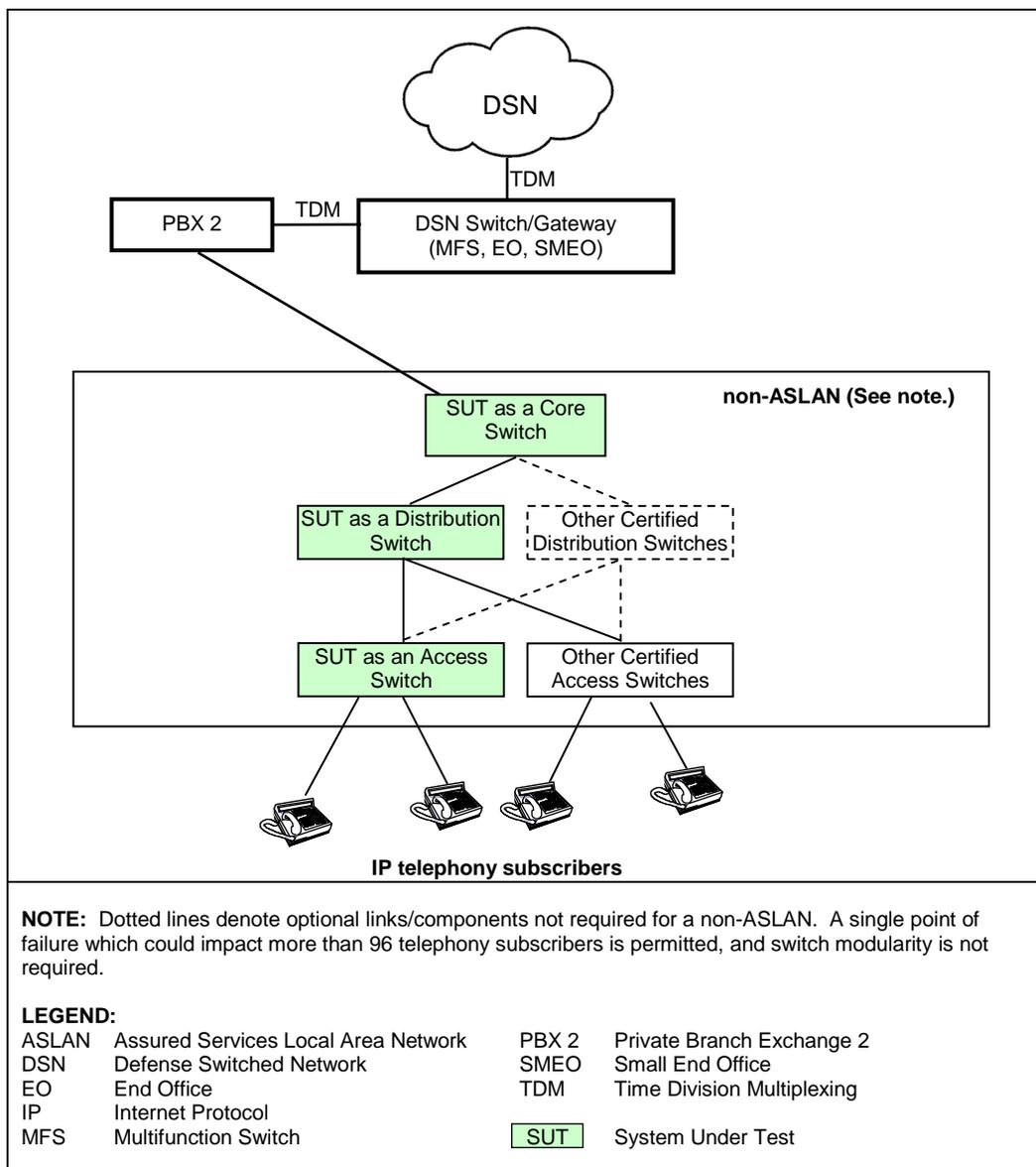


Figure 2-3. SUT Notional Non-ASLAN VoIP Architecture

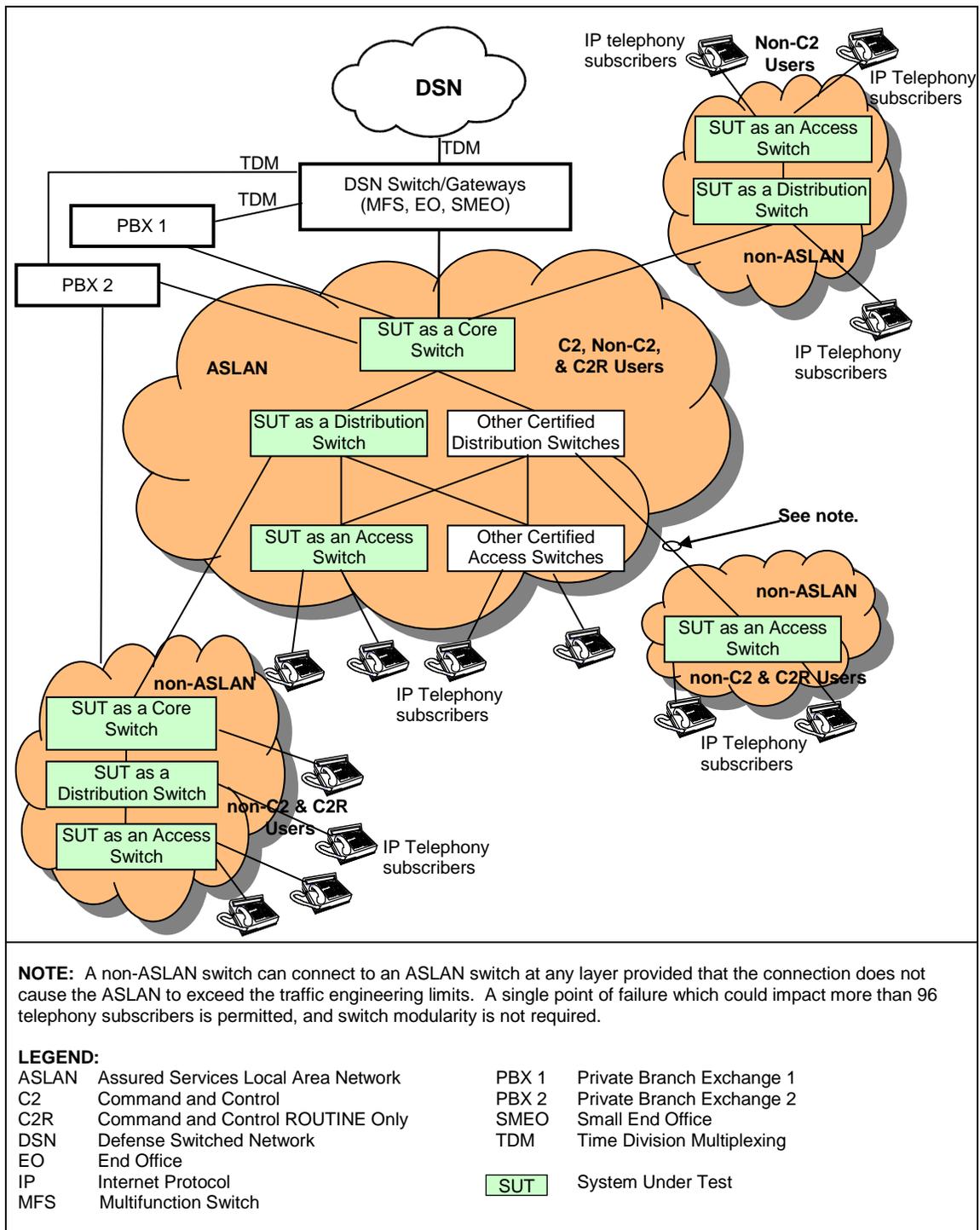


Figure 2-4. SUT Notional ASLAN and non-ASLAN Combined VoIP Architecture

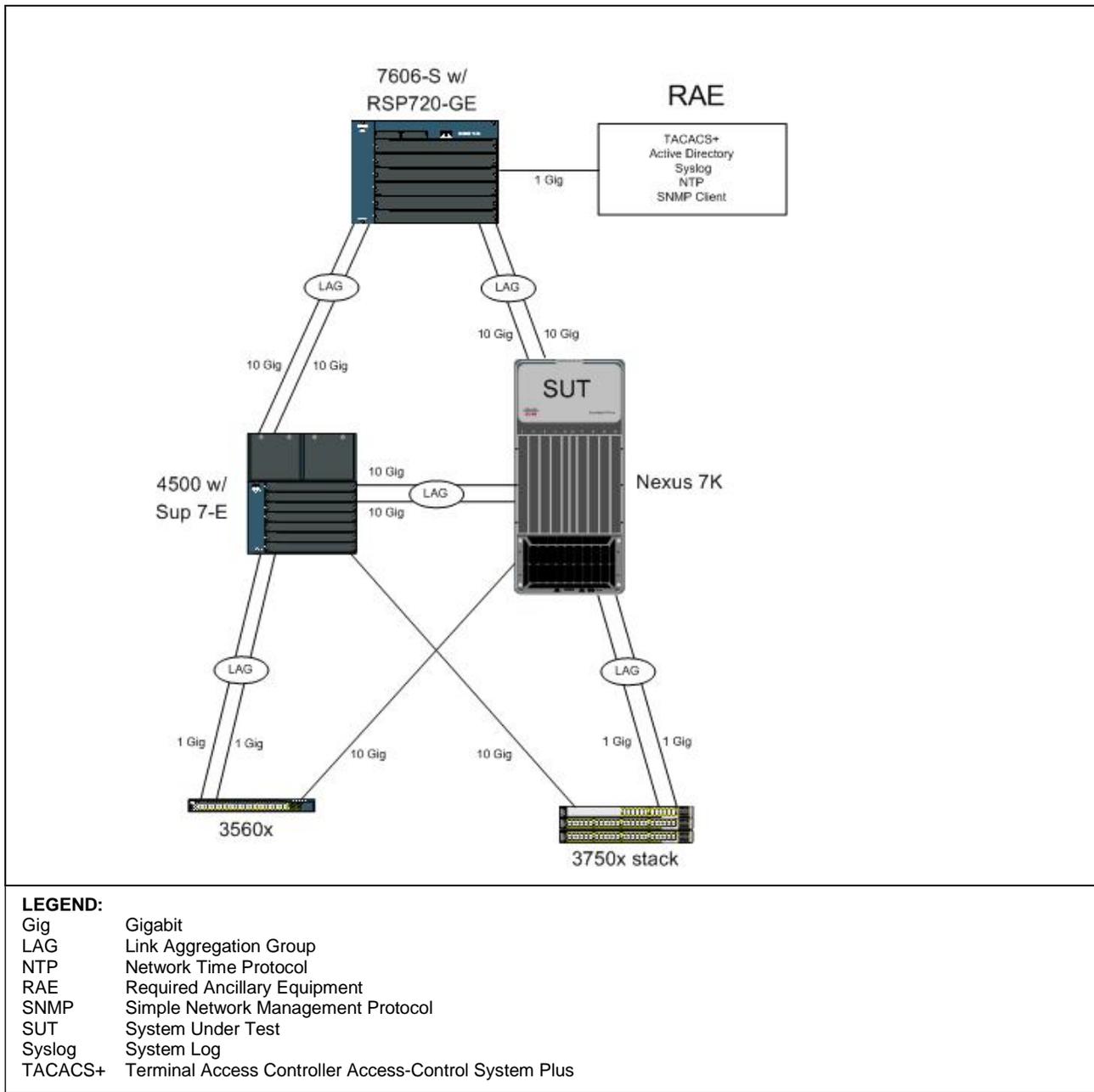
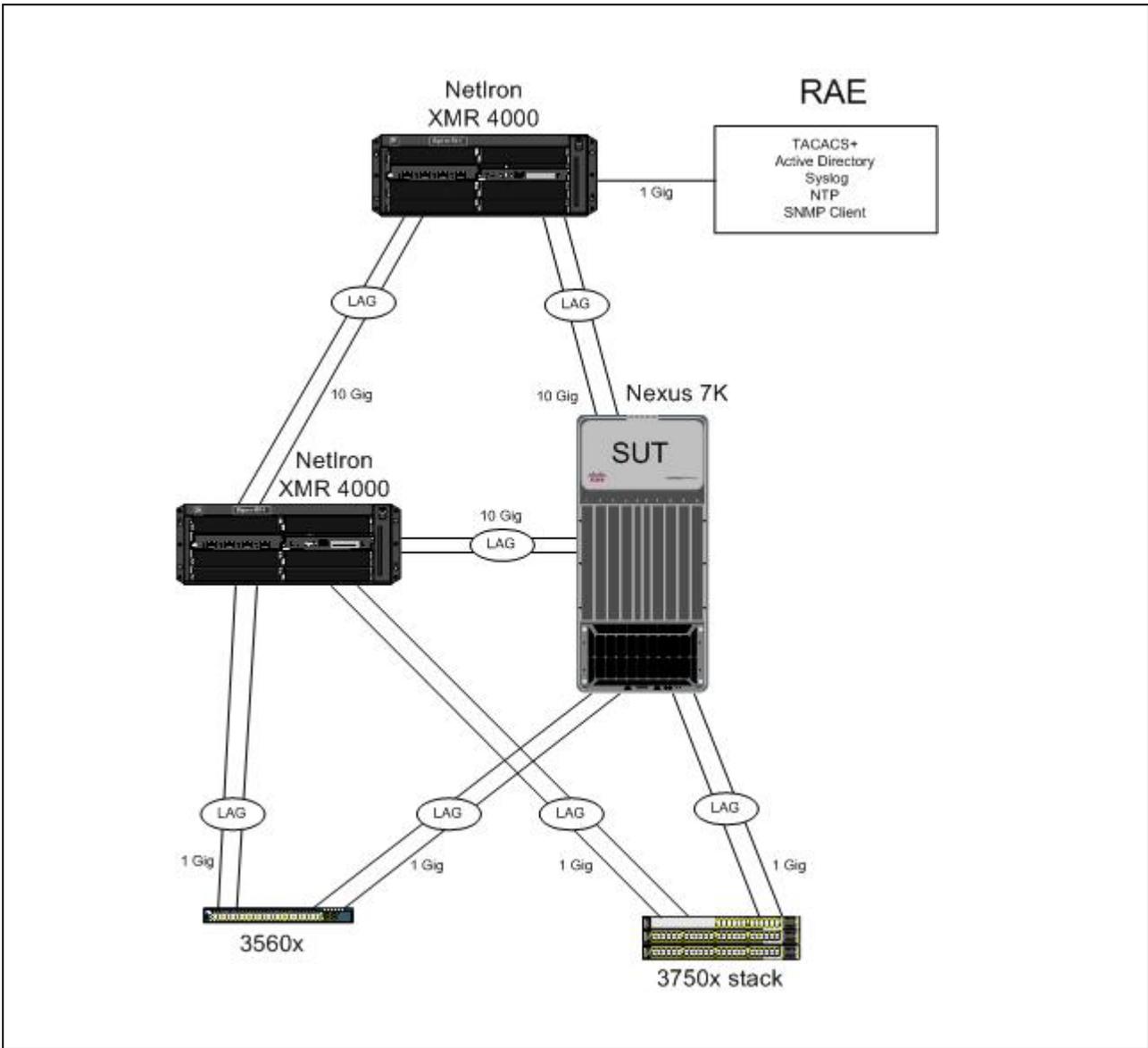


Figure 2-5. Homogeneous Test Configuration



- LEGEND:**
- Gig Gigabit
 - LAG Link Aggregation Group
 - NTP Network Time Protocol
 - RAE Required Ancillary Equipment
 - SNMP Simple Network Management Protocol
 - Syslog System Log
 - SUT System Under Test
 - TACACS+ Terminal Access Controller Access-Control System Plus
 - XMR Brocade NetIron XMR

Figure 2-6. SUT Heterogeneous Test Configuration with Brocade

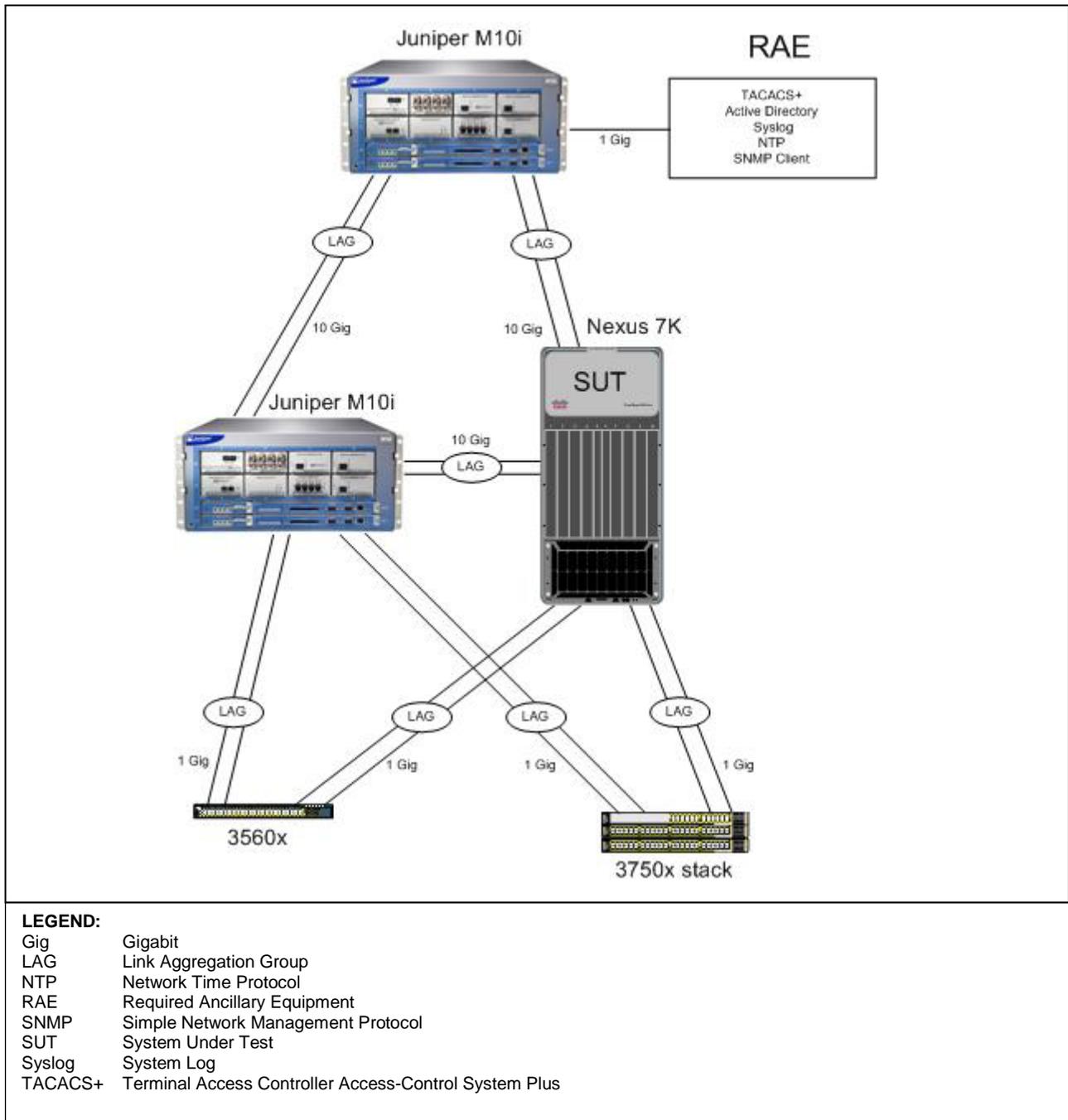


Figure 2-7. SUT Heterogeneous Test Configuration with Juniper

9. SYSTEM CONFIGURATIONS. Table 2-2 provides the system configurations, hardware, and software components tested with the SUT. The SUT is certified with other IP systems listed on the UC APL that are certified for use with an ASLAN or non-ASLAN.

Table 2-2. Tested System Configuration

System Name		Release																		
Cisco 7606-S w/ RSP720-GE		12.2(33)SRE2																		
Cisco Catalyst 4500 w/ Sup 7-E		IOS XE 3.1(1)SG																		
Cisco Catalyst 3750x		IOS 12.2(55)SE1																		
Cisco Catalyst 3560x		IOS 12.2(55)SE1																		
Brocade NetIron XMR 4000		FI 4.0.0f																		
Brocade FastIron GS 624P		FI 4.3.02a																		
Juniper M10i		Junos 8.5 R4.3																		
SUT (See note.)	Release	Function	Sub-component (See note.)	Description																
Cisco Nexus 7000																				
<u>N7K-C7010</u> <u>N7K-C7018</u>	NX OS 5.1(1a)	Core, Distribution, Access	<u>N7K-SUP1</u>	<u>Cisco Nexus 7000 Series Supervisor Module</u>																
			<u>N7K-M148GT-11</u>	<u>Cisco Nexus 7000 Series 48-Port 10/100/1000 Ethernet Module</u>																
			<u>N7K-M148GS-11L</u>	<u>Cisco Nexus 7000 Series 48-Port Gigabit Ethernet Module with XL Option (SFP)</u>																
			<u>N7K-M148GS-11</u>	Cisco Nexus 7000 Series 48-Port Gigabit Ethernet Module (SFP)																
			<u>N7K-M132XP-12</u>	<u>Cisco Nexus 7000 Series 32-Port 10Gb Ethernet Module with 80Gbps Fabric (SFP+)</u>																
			<u>N7K-M132XP-12L</u>	<u>Cisco Nexus 7000 Series 32-Port 10Gb Ethernet Module with XL Option</u>																
			<u>N7K-M108X2-12L</u>	<u>Cisco Nexus 7000 Series 8-Port 10Gb Ethernet Module (X2)</u>																
<p>NOTE: Components bolded and underlined were tested by USAISEC TIC. The other components in the family series were not tested; however, they use the same software and hardware, and JITC analysis determined this switches to be functionally identical for interoperability certification purposes. As such, they are also certified for joint use.</p> <p>LEGEND:</p> <table> <tr> <td>GB</td> <td>Gigabit</td> <td>SUT</td> <td>System Under Test</td> </tr> <tr> <td>Gbps</td> <td>Gigabits per second</td> <td>USAISEC TIC</td> <td>U.S. Army Information Systems Engineering Command Technology Integration Center</td> </tr> <tr> <td>JITC</td> <td>Joint Interoperability Test Command</td> <td>XMR</td> <td>Brocade NetIron XMR</td> </tr> <tr> <td>SFP</td> <td>Small Form Factor Pluggable</td> <td></td> <td></td> </tr> </table>					GB	Gigabit	SUT	System Under Test	Gbps	Gigabits per second	USAISEC TIC	U.S. Army Information Systems Engineering Command Technology Integration Center	JITC	Joint Interoperability Test Command	XMR	Brocade NetIron XMR	SFP	Small Form Factor Pluggable		
GB	Gigabit	SUT	System Under Test																	
Gbps	Gigabits per second	USAISEC TIC	U.S. Army Information Systems Engineering Command Technology Integration Center																	
JITC	Joint Interoperability Test Command	XMR	Brocade NetIron XMR																	
SFP	Small Form Factor Pluggable																			

10. TESTING LIMITATIONS. None.

11. TEST RESULTS.

a. Test Conduct. The SUT was tested as a Core, Distribution, and Access switch in both homogeneous and heterogeneous ASLAN configurations. It met all of the requirements by means of testing and/or the vendor's LoC, as outlined in the subparagraphs below. All requirements are for Core, Distribution, and Access Layer components unless otherwise specified.

(1) The UCR 2008, Change 2, paragraphs 5.3.1.2.1, 5.3.1.7.7, 5.3.1.7.7.1, and 5.3.1.7.7.2, state that ASLAN components can have no single point of failure for more

than 96 users for C2 and Special C2 users. The UCR 2008, Change 2, Paragraph 5.3.1.7.7, states the following redundancy requirements: Redundancy can be met if the product itself provides redundancy internally or if a secondary product is added to the ASLAN to provide redundancy to the primary product. Single-product redundancy may be met with a modular chassis that, at a minimum, provides the following: dual power supplies, dual processors, termination sparing, redundancy protocol, no single point of failure, and switch fabric or backplane redundancy. In the event of a component failure in the network, all calls that are active shall not be disrupted (loss of existing connection requiring redialing), and the path through the network shall be restored within five seconds. If a secondary product has been added to provide redundancy to a primary product, the failover to the secondary product must meet the same requirements. Non-ASLAN components can have a single point of failure for C2R and non-C2 users. The SUT supports more than 96 users and is equipped with redundant uplinks. A standard load of 100 percent of the total bandwidth was used, with 50 percent each of IPv4 and IPv6 traffic. Non-Link Aggregation Control Protocol (LACP) link failover was achieved within 1136 ms. For a heterogeneous network with Brocade, the maximum Non-LACP link failover time was 2635 ms. For a heterogeneous network with Juniper, the maximum non-LACP failover was 198 ms. LACP failover was 1586 ms in a homogeneous network, 1011 ms in heterogeneous network with Brocade, and 59 ms in a heterogeneous network with Juniper. The central processing unit (CPU) failover was 0.0 ms, and the switch fabric failover was 0.0 ms.

(2) The UCR 2008, Change 2, Paragraph 5.3.1.3, states that the ASLAN infrastructure components shall meet the requirements in the subparagraphs below. The SUT was tested using 100 percent of the total aggregate uplink bandwidth, with 50 percent each IPv4 and IPv6 traffic. The test included 24.9 percent each of best effort data, Operations, Administration and Maintenance (OAM), and video traffic; 20.9 percent voice traffic; and 2 percent each of network management and voice/video signaling.

(a) The Core and Distribution products shall be non-blocking for a minimum of 50 percent, and Access products shall be non-blocking for 12.5 percent (maximum voice and video traffic) of their respective maximum rated output capacity for egress ports that interconnect (trunk) the product to other products. Non-blocking is defined as the capability to send and receive 64- to 1,518-byte packets at full duplex rates from ingress ports to egress ports without losing any packets. The SUT met this requirement for all of the test cases by ensuring that higher-priority traffic was queued above lower-priority traffic and best effort data.

(b) The SUT shall have the capability to transport prioritized voice packets (media and signaling) with jitter of no more than 1 millisecond (ms) across all switches. All ASLAN infrastructure components shall have the capability to transport prioritized video packets (media and signaling) with jitter of no more than 10 ms across all switches. The jitter shall be achievable over any five-minute period measured from

ingress ports to egress ports under congested conditions. The SUT met this requirement with a measured jitter of 0.0016 ms for video and 0.0017 ms for voice.

(c) All Core, Distribution, and Access products shall have the capability to transport prioritized voice packets with no more than 0.015 percent packet loss. All Core, Distribution, and Access products shall have the capability to transport prioritized video and preferred data packets with no more than 0.05 percent packet loss. The packet loss shall be achievable over any five-minute period measured from ingress ports to egress ports under congested conditions. The SUT met this requirement with a measured packet loss of 0.00 percent for all traffic types.

(d) The SUT shall have the capability to transport prioritized voice packets (media and signaling), with latency of no more than 2 ms. All ASLAN infrastructure components shall have the capability to transport prioritized video packets (media and signaling), with latency of no more than 10 ms. The latency shall be achievable over any five-minute period measured from ingress ports to egress ports under congested conditions. The SUT met this requirement with a measured latency of 0.038 ms or less for all traffic types.

(3) The UCR 2008, Change 2, Paragraph 5.3.1.3.1, states that, at a minimum, Core and Distribution products shall provide the following interface rates: 100 megabits per second (Mbps) in accordance with (IAW) IEEE 802.3u, and 1 gigabit per second (Gbps) IAW IEEE 802.3z. Other rates may be provided as conditional interfaces. At a minimum, Access products shall provide one of the following interface rates: 10 Mbps IAW IEEE 802.3i, 100 Mbps IAW IEEE 802.3u, or 1000 Mbps IAW IEEE 802.3ab and IEEE 802.3z. Other rates may be provided as conditional interfaces. Refer to Table 2-3 for a detailed list of the interfaces that were tested. The SUT met these requirements.

Table 2-3. SUT Interface Status

Interface	Applicability			CRs/FRs (See note 1.)	Status		
	Co	D	A		Co	D	A
Network Management Interfaces for Core Layer Switches							
EIA/TIA-232 (Serial)	R	R	R	EIA/TIA-232	Met	Met	Met
IEEE 802.3i (10BaseT UTP)	C	C	C	1, 6-15, 18-28, 31, 32-36, 48-53, 58-60, 65, 67-71	Met	Met	Met
IEEE 802.3u (100BaseT UTP)	C	C	C	1, 6-15, 18-28, 31, 32-36, 48-53, 58-60, 65, 67-71	Met	Met	Met
IEEE 802.3ab (1000BaseT UTP)	C	C	C	1, 6-15, 18-28, 31, 32-36, 48-53, 58-60, 65, 67-71	Met	Met	Met
Uplink Interfaces for Core Layer Switches							
IEEE 802.3u (100BaseT UTP)	R	R	C ²	1-15, 16, 18-24, 28-31, 40, 44-53, 55-60, 65-75	Met	Met	Met
IEEE 802.3u (100BaseFX)	C	C	C ²	1-6, 11, 16, 18-24, 28-31, 40-41, 44-53, 55-60, 65-75	Not Supported		
IEEE 802.3ab (1000BaseT UTP)	C	C	C ²	1-16, 18-24, 28-31, 40, 44-53, 55-60, 65-75	Met	Met	Met
IEEE 802.3z (1000BaseX Fiber)	R	R	C ²	1-5, 8-16, 18-24, 28-31, 40, 44-53, 55-60, 65-75	Met	Met	Met
IEEE 802.3ae (10GBaseX)	C	C	C ²	1-5, 8-16, 18, 19, 40-41, 44-53, 55-60, 65-75	Met	Met	Met
Access Interfaces for Core Layer Switches							
IEEE 802.3i (10BaseT UTP)	C	C	C ²	1-15, 18-24, 28-41, 44-54, 58-71	Met	Met	Met
IEEE 802.3u (100BaseT UTP)	R	R	C ²	1-15, 18-24, 28-41, 44-54, 58-71	Met	Met	Met
IEEE 802.3u (100BaseFX)	C	C	C ²	1-6, 11, 18-24, 28-31, 44-54, 58-71	Not Supported		
IEEE 802.3ab (1000BaseT UTP)	C	C	C ²	1-15, 18-24, 28-41, 44-54, 58-71	Met	Met	Met
IEEE 802.3z (1000BaseX Fiber)	R	R	C ²	1-6, 11, 18-24, 28-31, 44-54, 58-71	Met	Met	Met
Generic Requirements for all Interfaces							
Generic Requirements not associated with specific interfaces	R	R	R	30-32, 35, 36, 40, 69-71	Met	Met	Met
DoD IPv6 Profile Requirements	R	R	R	UCR Section 5.3.5.5	Met	Met	Met
Security	R	R	R	UCR Sections 5.3.1.3.8, 5.3.1.5, 5.3.1.6, and 5.4	Met ³	Met ³	Met ³
NOTES:							
<p>1. The SUT's specific capability and functional requirement ID numbers listed in the CRs/FRs column can be cross-referenced in Table 2-2. These requirements apply to the following Cisco switches which are certified in the ASLAN Core, Distribution, and Access layers: Switch Cisco N7K-C7010 and Switch N7K-C7018. The devices listed in Table 2-2 that are not bolded or underlined are in the same family series as the SUT but were not tested. However, they utilize the same OS software and hardware, and JITC analysis determined this switch to be functionally identical for interoperability certification purposes.</p> <p>2. Access layer switches are required to support only one of the following IEEE interfaces: 802.3i, 802.3j, 802.3u, 802.3ab, or 802.3z.</p> <p>3. Security testing is accomplished via DISA-led Information Assurance test teams, and the results are published in a separate report, Reference (e).</p>							
LEGEND:							
802.3ab	1000BaseT Gbps Ethernet over twisted pair at 1 Gbps (125 Mbps)	Co	Core	CR	Capability Requirement		
802.3ae	10 Gbps Ethernet	D	Distribution				
802.3i	10BaseT Mbps over twisted pair	DISA	Defense Information Systems Agency				
802.3u	Standard for carrier sense multiple access with collision detection at 100 Mbps	EIA	Electronic Industries Alliance				
802.3z	Gigabit Ethernet Standard	EIA-232	Standard for defining the mechanical and electrical characteristics for connecting Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) data communications devices				
10BaseT	10 Mbps (Baseband Operation, Twisted Pair) Ethernet	FR	Functional Requirement				
100BaseT	100 Mbps (Baseband Operation, Twisted Pair) Ethernet	ID	Identification				
100BaseFX	100 Mbps Ethernet over fiber	IEEE	Institute of Electrical and Electronics Engineers				
1000BaseFX	1000 Mbps Ethernet over fiber	IPv6	Internet Protocol version 6				
1000BaseT	1000 Mbps (Baseband Operation, Twisted Pair) Ethernet	JITC	Joint Interoperability Test Command				
10GBaseX	10000 Mbps Ethernet over Category 5 Twisted Pair Copper	OS	Operating System				
A	Access	R	Required				
ASLAN	Assured Services Local Area Network	SUT	System Under Test				
C	Conditional	TIA	Telecommunications Industry Association				
		UCR	Unified Capabilities Requirements				
		UTP	Unshielded Twisted Pair				

(4) The UCR 2008, Change 2, Paragraph 5.3.1.3.2, states that the ASLAN infrastructure components shall provide the following parameters on a per port basis: auto-negotiation, force mode, flow control, filtering, link aggregation, Spanning Tree Protocol, multiple spanning tree, rapid reconfiguration of spanning tree, and port-based access control. The SUT was tested with a series of forced port speeds as well as auto-negotiation. Link failover testing was performed and confirmed spanning tree convergence. All of these requirements were also met through the vendor's LoC.

(5) The UCR 2008, Change 2, Paragraph 5.3.1.3.3, states that the ASLAN infrastructure components shall support Differentiated Services Code Points (DSCP) IAW Request for Comment (RFC) 2474 as stated in the subparagraphs below:

(a) The ASLAN infrastructure components shall be capable of accepting any packet with a DSCP value between 0 and 63 on an ingress port and assigning that packet to a Quality of Service (QoS) behavior listed in Section 5.3.1.3.6. Using an IP traffic generator, the SUT prioritized the traffic described below for queuing from lowest to highest with distinct IPv4 DSCP values. The IP load included 100 percent of the total aggregate uplink bandwidth, with 50 percent each IPv4 and IPv6 traffic. The test included 24.9 percent each of best effort data, OAM, and video traffic; 20.9 percent voice traffic; and 2 percent each of network management and voice/video signaling. The IP traffic generator/measurement tool recorded higher-prioritized traffic properly queued by the SUT above the lower-prioritized best effort traffic. In addition, it was verified that the SUT is capable of assigning a DSCP value from 0-63 for each type of traffic, which met this requirement.

(b) The ASLAN infrastructure components shall be capable of accepting any packet with a DSCP value between 0 and 63 on an ingress port and reassigning that packet to any new DSCP value (0-63). The current DSCP values are provided in Section 5.3.3.3.2. This requirement was met per the vendor's LoC.

(c) The ASLAN infrastructure components must be able to support the prioritization of aggregate service classes with queuing IAW Section 5.3.1.3.6. Using an IP traffic generator, the SUT prioritized the traffic described below for queuing from lowest to highest with distinct IPv6 service class values. The IP load included 100 percent of the total aggregate uplink bandwidth, with 50 percent each IPv4 and IPv6 traffic. The test included 24.9 percent each of best effort data, OAM, and video traffic; 20.9 percent voice traffic; and 2 percent each of network management and voice/video signaling. The IP traffic generator tool recorded higher-prioritized traffic properly queued by the SUT above the lower-prioritized best effort traffic. In addition, per the vendor's LoC, the SUT is capable of assigning IPv6 traffic class values from 0-63 for each type of traffic, thus meeting this requirement.

(d) The ASLAN infrastructure components may support the 3-bit user priority field of the IEEE 802.1Q 2-byte Tag Control Information (TCI) field. Default values are provided in Table 5.3.1-4. If the field is supported, the following Class of

Service (CoS) requirements apply: The ASLAN infrastructure components shall be capable of accepting any frame with a user priority value (0-7) on an ingress port and assigning that frame to a QoS behavior listed in Section 5.3.1.3.6. The ASLAN infrastructure components shall be capable of accepting any frame with a user priority value (0-7) on an ingress port and reassigning that frame to any new user priority value (0-7). This requirement was met per the vendor's LoC.

(6) The UCR 2008, Change 2, Paragraph 5.3.1.3.4, states that the ASLAN infrastructure components shall be capable of the Virtual LAN (VLAN) capabilities IAW IEEE 802.1Q. The SUT was configured with a preset VLAN ID tag using the IP loader. The load was captured at the egress and ingress to ensure that the SUT assigned the VLAN ID in the proper VLAN. The data was not modified or misplaced, and the assigned VLAN traffic was not lost. In addition, per the vendor's LoC the SUT has the capability to assign any VLAN ID any value from 1 through 3967 and from 4048 to 4093. VLAN IDs 3968 to 4047 and 4094 are internally reserved for virtualization and cannot be manually reassigned.

(7) The UCR 2008, Change 2, Paragraph 5.3.1.3.5, states that the ASLAN infrastructure components shall meet the Department of Defense Information Technology Standards Registry (DISR) protocol requirements for IPv4 and IPv6. Using an IP traffic generator, the SUT prioritized the traffic described below for queuing from lowest to highest with distinct IPv4 DSCP values and IPv6 service class values. The SUT was tested using 100 percent of the total aggregate uplink bandwidth, with 50 percent each IPv4 and IPv6 traffic. The test included 24.9 percent each of best effort data, OAM, and video traffic; 20.9 percent voice traffic; and 2 percent each of network management and voice/video signaling. The IP traffic generator/measurement tool recorded higher-prioritized traffic properly queued by the SUT above lower-prioritized best effort traffic. The IPv4 DISR protocol requirements were met by the vendor's LoC, and the IPv6 DISR protocol requirements were partially met.

(8) The UCR 2008, Change 2, Paragraph 5.3.1.3.6, states that the ASLAN infrastructure components shall be capable of providing the following QoS features:

(a) Provide a minimum of four queues. The N7K-M108X2-12L, N7K-M132XP-12L, and N7K-M132XP-12 SUTs have the ability to support up to eight assignable queues, however, only a four-queue model was tested and is covered under this certification. The N7K-M148GS-11, N7K-M148GT-11, and N7K-M148GS-11L SUTs all support four egress queues.

(b) Assign a DSCP or Traffic Class value to any of the queues. The SUT met this requirement through testing.

(c) Support Differentiated Services (DiffServ) per hop behaviors (PHBs) in accordance with RFCs 2474, 2597, 2598, 3140, and 3246. The SUT met this requirement through testing of the queuing process.

(d) Support, at a minimum, one of the following: Weighted Fair Queuing (WFQ) IAW RFC 3662, Priority Queuing (PQ) IAW RFC 1046, or Class-Based WFQ IAW RFC 3366. The SUT met this requirement with Priority Queuing. Note that RFC 1046 is not a standard.

(e) All queues shall be capable of having bandwidth assigned or percentage of traffic. Using an IP traffic generator, the SUT prioritized the traffic described below for queuing from lowest to highest with distinct IPv4 DSCP values and IPv6 service class values. The SUT was tested using 100 percent of the total aggregate uplink bandwidth, with 50 percent each IPv4 and IPv6 traffic. The test included 24.9 percent each of best effort data, OAM, and video traffic; 20.9 percent voice traffic; and 2 percent each of network management and voice/video signaling. The IP traffic generator/measurement tool recorded higher-prioritized traffic properly queued by the SUT above the lower-prioritized best effort traffic. The IP traffic generator/measurement tool also recorded higher-prioritized traffic properly queued by the SUT above the lower-prioritized best effort traffic at the assigned bandwidth per queue. Subsequently, the IP test equipment was reconfigured to increase the video traffic at 35 percent of line rate to ensure the SUT allowed only 25 percent throughput of the video traffic. The captured video throughput measured by the IP traffic generator/measurement tool was 26.26 percent of the line rate, which was within the allowable window of 25 percent +/- 2 percent.

(9) The UCR 2008, Change 2, Paragraph 5.3.1.3.7, states that the ASLAN infrastructure components shall be capable of providing the following Network Monitoring features:

(a) Simple Network Management Protocol (SNMP) IAW RFCs 1157, 2206, 3410, 3411, 3412, 3413, and 3414. The SUT met the requirements for RFCs 1157, 3411, 3412, 3413, 3414 through the vendor's LoC. RFC 3414 was also met through testing. RFC 2206 is not an SNMP standard; it defines the Resource Reservation Protocol Management Information Base (RSVP MIB) only. Since RSVP functionality is not supported on the SUT, RFC 2206 is not applicable. RFC 3410 is Informational: "This memo provides information for the Internet community. It does not specify an Internet-standard of any kind." As such, RFC 3410 is not applicable.

(b) SNMP Traps IAW RFC 1215. The SUT met this requirement through testing. The SilverCreek® SNMP Test Suite was used to capture SNMP traps. For the port configuration change test, the speed of an individual port on each switch was changed from 1000 to 100 and back again. All of the switches sent a trap, "CISCO-CONFIG-MAN-MIB", but the trap did not specify a port number.

(c) Remote Monitoring (RMON) IAW RFC 2819. The SUT met this requirement through the vendor's LoC.

(d) Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework IAW RFC 3584. RFC 3584 is not a standard; it is a Best Current Practice. As such, RFC 3584 is not applicable.

(e) The Advanced Encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model IAW RFC 3826. Security is tested by DISA-led Information Assurance test teams, and the results are published in a separate report, Reference (e).

(10) The UCR 2008, Change 2, Paragraph 5.3.1.3.9, states that all switches shall/must meet Product Requirements IAW UCR 2008, Change 2, Table 5.3.1-5. The SUT met these requirements listed in Table 5.3.1-5 as stipulated throughout this document by testing and/or confirmation of the vendor's LoC.

(11) The UCR 2008, Change 2, Section 5.3.1.4, states that the ASLAN infrastructure components shall be capable of meeting the End-to-End (E2E) performance requirements for voice, video, and data services. End-to-end performance across a LAN is measured from the traffic ingress point to the traffic egress point. The requirements are measured over any five-minute period under congested conditions. A congested condition is defined as using 100 percent of the total aggregate uplink bandwidth, with 50 percent each IPv4 and IPv6 traffic. The test included 24.9 percent each of best effort data, OAM, and video traffic; 20.9 percent voice traffic; and 2 percent each of network management and voice/video signaling. The test also included 100 percent of the link capacities as defined by baseline traffic engineering: 25 percent voice/signaling, 25 percent video, 25 percent preferred data, and 25 percent best effort traffic. The E2E requirements are ASLAN requirements. However, all of the E2E voice, video, and data services performance requirements were met by the SUT when included within an ASLAN. Refer to paragraphs 11.b.(2)(b), 11.b.(2)(c), and 11.b.(2)(d).

(12) The UCR 2008, Change 2, Section 5.3.1.6, states that LAN infrastructure components must meet the requirements in the subparagraphs below. Near Real Time (NRT) is defined as within five seconds of detecting the event, excluding transport time.

(a) Local area networks shall have the ability to perform remote network product configuration/reconfiguration of objects that have existing DoD Global Information Grid (GIG) management capabilities. The network management system (NMS) shall report configuration change events in NRT, whether or not the change was authorized. The system shall report the success or failure of authorized configuration change attempts in NRT. The SUT met this requirement through testing.

(b) Local area network infrastructure components must provide metrics to the NMS to allow it to make decisions on managing the network. Network management systems shall have an automated NM capability to obtain the status of networks and associated assets in NRT 99 percent of the time (with 99.9 percent as an Objective Requirement). Specific metrics are defined in UCR 2008, Change 2, Sections 5.3.2.17 and 5.3.2.18. The SUT met this requirement through the vendor's LoC.

(c) Local area network components shall be capable of providing status changes 99 percent of the time (with 99.9 percent as an Objective Requirement) by means of an automated capability in NRT. An NMS will have an automated NM capability to obtain the status of networks and associated assets 99 percent of the time (with 99.9 percent as an Objective Requirement) in NRT. The NMS shall collect statistics and monitor bandwidth utilization, delay, jitter, and packet loss. The SUT met this requirement through the vendor's LoC.

(d) Local area network components shall be capable of providing SNMP alarm indications to an NMS. The NMS will have the NM capability to perform automated fault management of the network, to include problem detection, fault correction, fault isolation and diagnosis, problem tracking until corrective actions are completed, and historical archiving. Alarms will be correlated to eliminate those that are duplicate or false, initiate tests, and perform diagnostics to isolate faults to a replaceable component. Alarms shall be reported as TRAPs via SNMP in NRT. More than 99.95 percent of alarms shall be reported in NRT. The SUT met this requirement through the the vendor's LoC.

(e) An NMS will have the NM capability of automatically generating and providing an integrated/correlated presentation of a network and all its associated networks. The SUT fully supports SNMP MIBs that can be used to build visual representations of the network using an NMS.

(13) The UCR 2008, Change 2, paragraphs 5.3.1.3.8, 5.3.1.5, 5.3.1.6, state that ASLAN components must meet security requirements. Security is tested by DISA-led Information Assurance test teams, and the results are published in a separate report, Reference (e).

(14) The UCR 2008 Change 2, Paragraph 5.3.1.7.6 states that ASLAN components must meet an availability of 99.999 percent for Special C2 users and 99.997 percent for C2 users. The SUT can provide 99.999 percent availability using software high-availability features (i.e., OSPF, VRRP, RSTP, etc.) and hardware redundancy. The SUT supports redundant processors, fabrics, power supplies, and interface modules to support > 96 users. Distributed EtherChannels can be used to spread uplinks across redundant interface cards. Please note that calculating actual LAN availability is site-specific. Each site will have a different Mean Time to Repair (MTTR) and LAN architecture (i.e., link redundancy, chassis redundancy, Supervisor redundancy, etc.).

b. System Interoperability Results. The SUT is certified for joint use within the DSN as a Core, Distribution, and Access Layer Switch. It is also certified with any digital switching systems listed on the UC APL which are certified for use with an ASLAN or non-ASLAN.

12. TEST AND ANALYSIS REPORT. In accordance with the Program Manager's request, no detailed test report was developed. The 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 <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/tssj>. Due to the sensitivity of the information, the Information Assurance Accreditation Package (IAAP) containing the approved configuration and deployment guide must be requested directly through Government civilian or uniformed military personnel in the Unified Capabilities Certification Office (UCCO); e-mail: ucco@disa.mil.