DEFENSE INFORMATION SYSTEMS AGENCY
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IN REPLY REFER TO: Joint Interoperability Test Command (JTE) 8 August 2017

MEMORANDUM FOR DISTRIBUTION

SUBJECT: Joint Interoperability Certification of Cisco 4000, 4010, and 5000 Series Industrial Ethernet Switches with Internetwork Operating System (IOS) 15.2E

References: (a) Department of Defense Instruction 8100.04, "DoD Unified Capabilities (UC)," 9 December 2010
(b) Office of the Department of Defense Chief Information Officer, "Department of Defense Unified Capabilities Requirements 2013, Change 1," June 2015
(c) through (d) see Enclosure 1

1. **Certification Authority.** Reference (a) establishes the Joint Interoperability Test Command (JITC) as the Joint Interoperability Certification Authority for Department of Defense Information Network (DoDIN) products, Reference (b).

2. **Conditions of Certification.** The Cisco 4000, 4010, and 5000 Series Industrial Ethernet Switches with IOS 15.2E, hereinafter is referred to as the System Under Test (SUT). The SUT meets the critical requirements of the Unified Capabilities Requirements (UCR), Reference (b), as an Assured Services Local Area Network (ASLAN) L2 Access Switch and is therefore certified for joint use on the DoDIN with the conditions specified in Table 1. This certification expires upon changes that affect interoperability, but no later than the expiration date specified in the DoDIN Approved Products List (APL) memorandum.

Table 1. Conditions

Description	Operational Impact	Remarks
UCR Waivers		
None		
Conditions of Fielding (CoF)		
To meet Access requirements, all uplink ports must be configured with fiber interfaces.	None with CoF	
Open Test Discrepancies		
None		

LEGEND:
CoF Conditions of Fielding UCR Unified Capabilities Requirements

3. **Interoperability Status.** Table 2 provides the SUT interface interoperability status, and Table 3 provides the Capability Requirements (CR) and Functional Requirements (FR) status. Table 4 provides a DoDIN APL product summary.

Table 2. Interface Status

Interface (See note 1.)	Applicability ASLAN			Status (Met, Partially Met, Not Met, Not Tested)	Remarks
	Co	D	A		
Network Management Interfaces					
IEEE 802.3i (10BaseT UTP)	C	C	C	Met	
IEEE 802.3u (100BaseT UTP)	C	C	C	Met	
IEEE 802.3ab (1000BaseT UTP)	C	C	C	Met	
Access (User) Interfaces (See note 2.)					
IEEE 802.3i (10BaseT UTP)	C	C	C	Met	
IEEE 802.3u (100BaseT UTP)	C	C	C	Met	
IEEE 802.3u (100BaseFX)	C	C	C	Not Tested	(See note 3.)
IEEE 802.3ab (1000BaseT UTP)	C	C	C	Met	
IEEE 802.3z (1000BaseX Fiber)	C	C	C	Met	
IEEE 802.3ae (10GBaseX)	C	C	C	Not Tested	(See note 3.)
IEEE 802.3ba (40GBaseX)	O	O	O	Not Tested	(See note 3.)
IEEE 802.3ba (100GBaseX)	O	O	O	Not Tested	(See note 3.)
Uplink (Trunk) Interfaces (See note 2.)					
IEEE 802.3u (100BaseT UTP)	O	O	O	Met	
IEEE 802.3u (100BaseFX)	O	O	O	Not Tested	(See note 3.)
IEEE 802.3ab (1000BaseT UTP)	O	O	O	Met	
IEEE 802.3z (1000BaseX Fiber)	C	C	C	Met	
IEEE 802.3ae (10GBaseX)	C	C	C	Met	(See note 4.)
IEEE 802.3ba (40GBaseX)	C	C	C	Not Tested	(See note 3.)
IEEE 802.3ba (100GBaseX)	C	C	C	Not Tested	(See note 3.)

NOTE(S):
1. The SUT high-level requirements are depicted in Table 3. These high-level requirements refer to a more detailed list of requirements provided in Enclosure 3, Table 3-2.
2. Core, Distribution, and Access products must minimally support one of the interfaces listed in this table as conditional for the given role. Other rates and standards may be provided as optional interfaces.
3. The SUT does not support this (conditional or optional) interface.
4. The only component of the SUT supporting this interface is the IE-5000-12S12P-10G.

LEGEND:

802.3ab	1000BaseT Gbps Ethernet over Twisted Pair	100GBaseX	100000 Mbps Ethernet over Fiber or Copper
802.3ae	10 Gbps Ethernet over Fiber	A	Access
802.3ba	40 and 100 Gigabit Ethernet over Twisted pair and Fiber	ASLAN	Assured Services Local Area Network
802.3i	10BaseT 10 Mbps Ethernet over Twisted Pair	C	Conditional
802.3u	Fast Ethernet at 100 Mbps, copper and Fiber	Co	Core
802.3z	Gigabit Ethernet over Fiber	D	Distribution
10BaseT	10 Mbps (Baseband Operation, Twisted Pair) Ethernet	Gbps	Gigabits per second
100BaseFX	100 Mbps Ethernet over Fiber	IEEE	Institute of Electrical and Electronics Engineers
100BaseT	100 Mbps (Baseband Operation, Twisted Pair) Ethernet	Mbps	Megabits per second
1000BaseT	1000 Mbps (Baseband Operation, Twisted Pair) Ethernet	O	Optional
1000BaseX	1000 Mbps Ethernet over Fiber or Copper	SUT	System Under Test
10GBaseX	10000 Mbps Ethernet over Fiber or Copper	UTP	Unshielded Twisted Pair
40GBaseX	40000 Mbps Ethernet over Fiber or Copper		

Table 3. Capability Requirements and Functional Requirements Status

CR/FR ID	UCR Requirement (See notes 1 and 2.)	UCR 2013 Change 1 Reference	Status (Met, Partially Met, Not Met, Not Tested)
1	General LAN Switch and Router Product Requirements (R)	7.2.1	Met
2	LAN Switch and Router Redundancy Requirements (R)	7.2.2	Met
3	LAN Product Requirements Summary (R)	7.2.3	Met
4	Multiprotocol Label Switching (O)	7.2.4	Not Tested (See note 3.)

NOTE(S):
1. The annotation of "required" refers to a high-level requirement category. Enclosure 3 addresses the applicability of each sub-requirement.
2. Security was tested by a TSSAP-led Cybersecurity test team and the results published in a separate report, Reference (d).
3. The SUT does not support this optional requirement.

LEGEND:

ASLAN	Assured Services Local Area Network	O	Optional
CR	Capability Requirement	R	Required
FR	Functional Requirement	SUT	System Under Test
ID	Identification	TSSAP	Telecommunications Systems Security Assessment Program
LAN	Local Area Network	UCR	Unified Capabilities Requirements

Table 4. SUT Product and Certification Summary

Product Identification			
Product Name	Cisco 4000, 4010, and 5000 Series Industrial Ethernet Switches		
Software Release	IOS 15.2E		
DoDIN Product Type(s)	Assured Services Local Area Network (ASLAN) Access Switch		
Product Description	The SUT enables switches to transport data, voice, signaling, and video media as part of an overall Voice over Internet Protocol (VoIP) system. This system delivers scalable performance and port density across a multi-chassis configuration using Layer 2 protocols, while providing shared access ports to the end user.		
DoDIN Certified Function	**Component/Sub-component Name (See notes 1 and 2.)**	**Tested Version**	**Remarks**
ASLAN Access Switch	**IE-4000-16GT4G-E** IE-4000-4TC4G-E IE-4000-8T4G-E IE-4000-8S4G-E IE-4000-4T4P4G-E IE-4000-16T4G-E IE-4000-4S8P4G-E IE-4000-8GT4G-E IE-4000-8GS4G-E IE-4000-4GC4GP4G-E IE-4000-8GT8GP4G-E IE-4000-4GS8GP4G-E **IE-4010-16S12P** IE-4010-4S24P **IE-5000-12S12P-10G** IE-5000-16S12P	IOS 15.2E	

NOTE(S):
1. Table 3-3 of Enclosure 3 provides the detailed component and subcomponent descriptions.
2. Components bolded and underlined were tested by TSSAP. The other components in the family series were not tested; however, JITC certifies the other components for joint use because they utilize the same software and similar hardware as the tested components and TSSAP analysis determined that they were functionally identical for interoperability certification purposes.

LEGEND:

ASLAN	Assured Services Local Area Network	SUT	System Under Test
DoDIN	Department of Defense Information Network	TSSAP	Telecommunications Systems Security Assessment Program
IOS	Internetwork Operating System	VoIP	Voice over Internet Protocol
JITC	Joint Interoperability Test Command		

4. **Test Details.** JITC bases this certification on interoperability testing, review of the vendor's Letters of Compliance (LoCs) and DISA adjudication of open Test Discrepancy Reports (TDRs) for inclusion on the DoDIN APL. The Telecommunications Systems Security Assessment Program (TSSAP), Joint Base San Antonio (JBSA), Lackland, Texas, conducted testing from 5 June through 16 June 2017 using test procedures derived from Reference (c). Review of the vendor's LoC was completed on 1 May 2017. TSSAP-led Cybersecurity test teams conducted Cybersecurity testing and published the results in a separate report, Reference (d). Enclosure 2 documents the test results and describes the tested network and system configurations. Enclosure 3 provides the detailed interface, capability, and functional requirements and test results.

5. **Additional Information.** JITC distributes interoperability information via the JITC Electronic Report Distribution (ERD) system, which uses Sensitive but Unclassified IP Data (formerly known as NIPRNet) e-mail. Interoperability status information is available via the JITC System Tracking Program (STP). STP is accessible by .mil/.gov users 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/. Due to the sensitivity of the information, the Cybersecurity Assessment Package (CAP) containing the approved configuration and deployment guide must be requested directly from the Approved Products Certification Office (APCO) via e-mail: disa.meade.ie.list.approved-products-certification-office@mail.mil. All associated information is available on the DISA APCO website located at http://www.disa.mil/Services/Network-Services/UCCO.

6. **Point of Contact (POC).** TSSAP testing POC: Mr. Ryan Bradshaw; commercial telephone 210-925-6900; e-mail address: ryan.bradshaw.3@us.af.mil. JITC certification POC: Lisa Esquivel; commercial telephone (520) 538-5531; DSN 879-5531; e-mail address lisa.r.esquivel.civ@mail.mil; mailing address Joint Interoperability Test Command, ATTN: JTE (Lisa Esquivel), P.O. Box 12798, Fort Huachuca, AZ 85670-2798. The APCO tracking number for the SUT is 1635601.

FOR THE COMMANDER:

CLARK.BRADLEY.ALAN.1231466564

Digitally signed by CLARK.BRADLEY.ALAN.1231466564
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=DISA, cn=CLARK.BRADLEY.ALAN.1231466564
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3 Enclosures a/s

for RIC HARRISON
Chief
Networks/Communications and UC Division

JITC Memo, JTE, Joint Interoperability Certification of Cisco 4000 and 5000 Series Industrial Ethernet Switches, IOS 15.2E

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ADDITIONAL REFERENCES

(c) Joint Interoperability Test Command, "Assured Services Local Area Network (ASLAN) and Non-ASLAN Test Procedures Version 1.2 for Unified Capabilities Requirements (UCR) 2013 Change 1," January 2017
(d) Joint Interoperability Test Command, "Cybersecurity (CS) Assessment of CISCO Industrial Ethernet Switches Software Release IOS 15.2E (Tracking Number 1635601)," July 2017

CERTIFICATION SUMMARY

1. SYSTEM AND REQUIREMENTS IDENTIFICATION. The Cisco Industrial Ethernet Switches, Software Release IOS 15.2E, is hereinafter referred to as the System Under Test (SUT). Table 2-1 depicts the SUT identifying information and requirements source.

Table 2-1. System and Requirements Identification

System Identification	
Sponsor	United States Air Force
Sponsor Point of Contact	Lt Joseph Baucke, Director, Network Services Directorate, Address: P.O. Box 549, Fort Meade, MD 20755-0549, e-mail: joseph.baucke.1@us.af.mil
Vendor Point of Contact	Cisco Systems Global Certification Team (GCT), 7025-2 Kit Creek Road, Research Triangle Park, North Carolina 27709, e-mail: certteam@cisco.com
System Name	CISCO Industrial Ethernet Switches
Increment and/or Version	IOS 15.2E
Product Category	Assured Services Local Area Network (ASLAN) Access Switch
System Background	
Previous certifications	N/A
Tracking	
APCO ID	1635601
System Tracking Program ID	System #6243, Test Activity #13232
Requirements Source	
Unified Capabilities Requirements	Unified Capabilities Requirements 2013, Change 1 Sections 4.2, 5.2, and, 7.2
Remarks	None
Test Organization(s)	TSSAP
LEGEND: APCO Approved Products Connection Office ASLAN Assured Services Local Area Network ID Identification	

2. SYSTEM DESCRIPTION. The Unified Capabilities Requirements (UCR) 2013, Change 1, defines two types of Local Area Networks (LANs): Assured Services Local Area Networks (ASLANs) and non-ASLANs. The LANs are designed to meet traffic engineering and redundancy requirements, as required by applicable mission needs. The ASLANs and non-ASLANs may be designed to use any combination of the layers and functional capabilities. ASLANs support assured services and provide enhanced availability and backup power while non-ASLAN need not meet assured services requirements. The Department of Defense Information Network (DoDIN) LAN components for both ASLAN and non-ASLAN are Core, Distribution, and Access switches. The core layer is a high-speed switching backbone designed to switch packets as quickly as possible. The distribution layer is the demarcation point between the access and core layers. The distribution layer helps to define and differentiate the core, provides boundary definition, and is the place at which packet manipulation can take place. The access layer is the point at which local end users are allowed into the network. This layer may use access lists or filters to optimize further the needs of a particular set of users.

The Cisco ASLAN enables switches to transport data, voice signaling, and video media as part of an overall Voice over Internet Protocol (VoIP) system. This system delivers scalable performance and port density across a multi-chassis configuration using Layer 2 protocols, while providing shared access ports to the end user.

The ASLAN network is configured with traditional Core, Distribution, and Access layers. The distribution layer provides fully redundant connectivity between the access and the core devices by using LACP, OSPF, and VRRP to create a robust architecture. Components enabled for Layer 3 use OSPFv2 and OSPFv3 routing protocols for dynamic routing.

Cisco's ASLAN components utilize advanced QOS features to prioritize Voice, Video, and Data traffic in accordance with the UCR 2013 Change 1 requirements.

Component 1. IE-4000-16GT4G-E

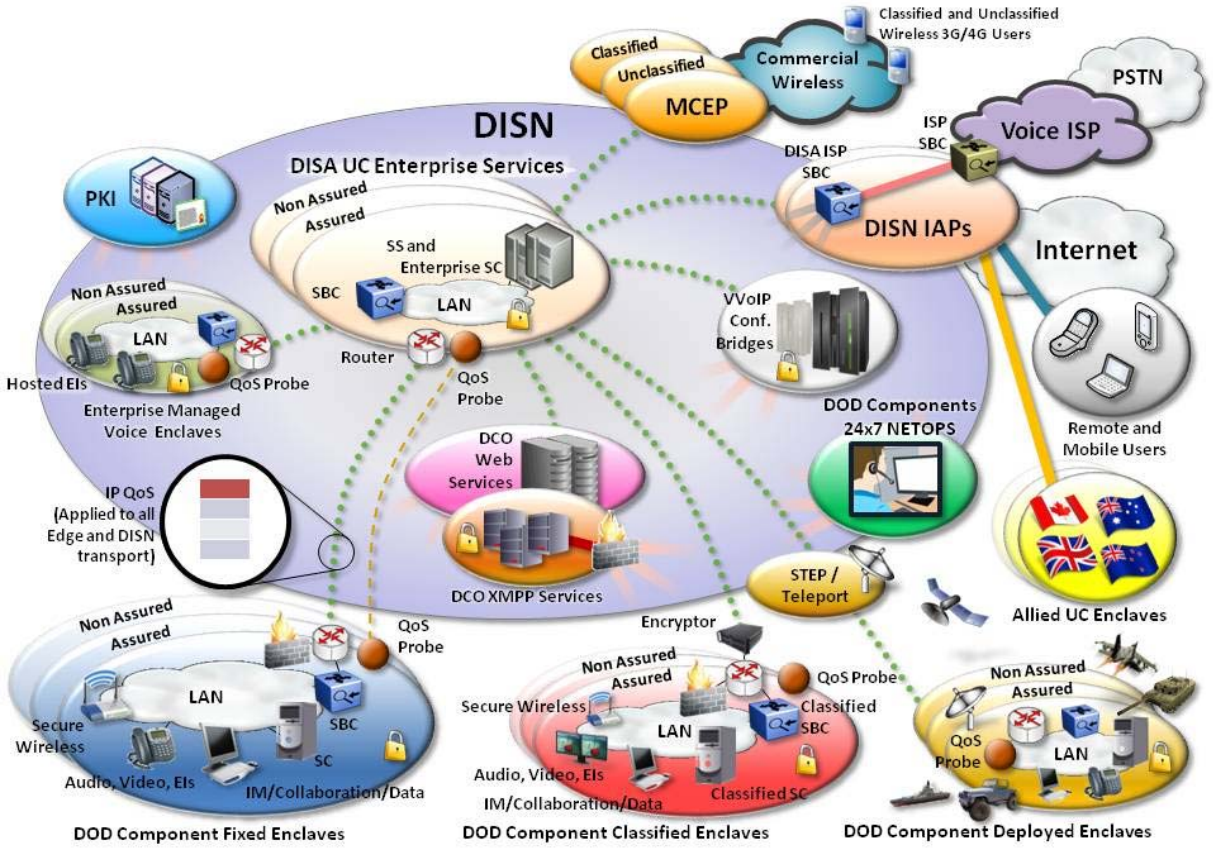
Component 2. IE-4010-16S12P

Component 3. IE-5000-12S12P-10G

3. OPERATIONAL ARCHITECTURE. The Department of Defense Information Network (DoDIN) architecture is a two-level network hierarchy consisting of Defense Information Systems Network (DISN) backbone switches and Service/Agency installation switches. The Department of Defense (DoD) Chief Information Officer (CIO) and Joint Staff policy and subscriber mission requirements determine which type of switch can be used at a particular location. The DoDIN architecture, therefore, consists of several categories of switches. Figure 2-1 depicts the notional operational DoDIN architecture in which the SUT may be used.

4. TEST CONFIGURATION. The test team tested the SUT at the Telecommunications Systems Security Assessment Program (TSSAP), JBSA-Lackland San Antonio, Texas in a manner and configuration similar to that of a notional operational environment depicted in Figure 2-1. The test team verified the SUT's required functions and features using the test configuration depicted in Figure 2-2. The test team conducted interoperability testing of the ASLAN components by testing the SUT with different vendor UC APL certified products as illustrated in Figure 2-2. Cybersecurity testing used the same configuration.

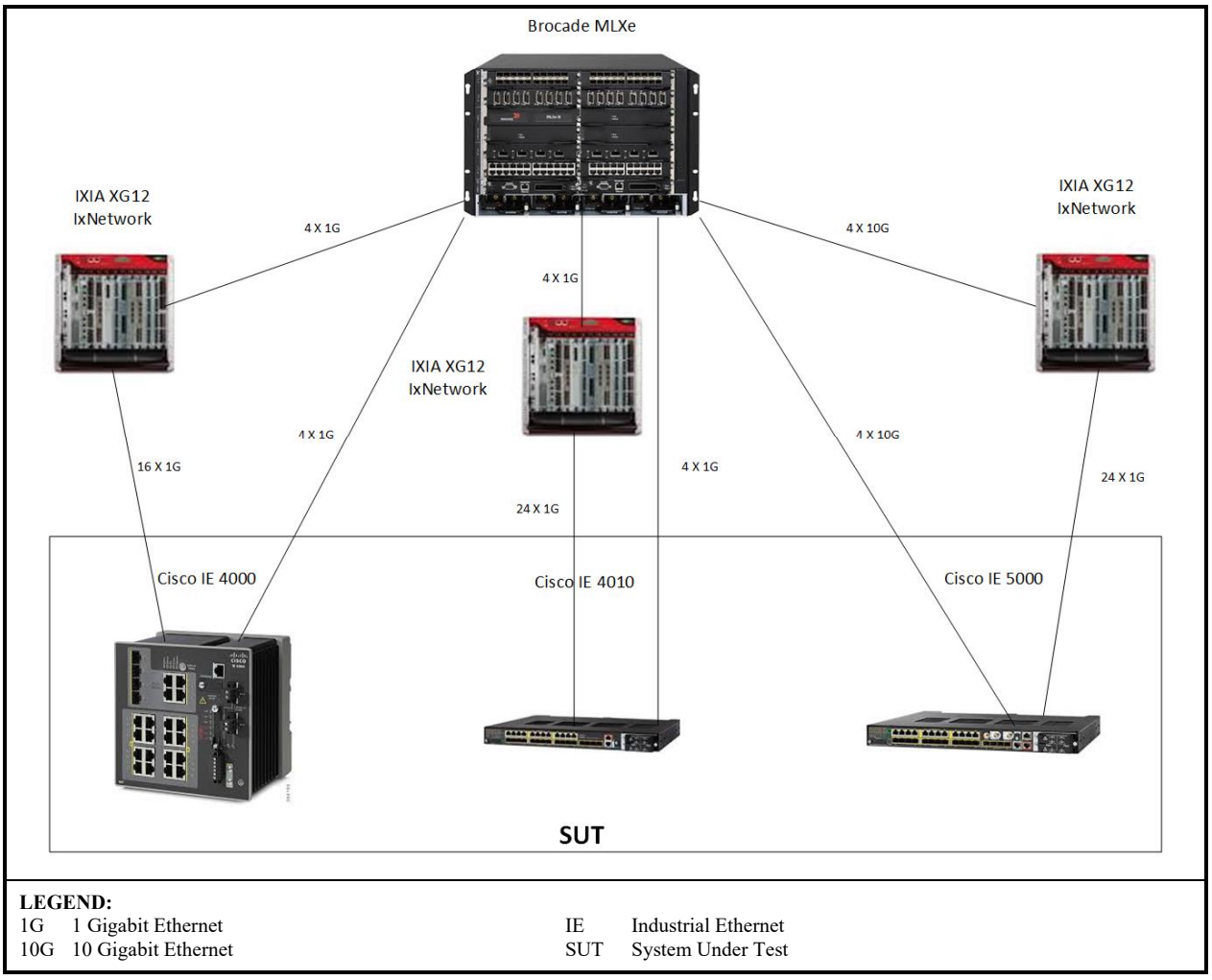
5. METHODOLOGY. TSSAP conducted testing of the ASLAN components using LAN requirements derived from the UCR 2013, Change 1, Reference (b), and the test procedures, Reference (c). Because of vendor maturity, testing is conducted using heterogeneous test configurations. Heterogeneous testing (Figure 2-2) is performed by placing the SUT components in a LAN comprised of multi-vendor LAN products. This verifies the interoperability of the LAN components within a Voice and Video over IP network (VVoIP). In addition to testing, an analysis of the vendor's Letters of Compliance (LoC) verified letter "R" requirements have been met. Any new discrepancy noted in the operational environment will be evaluated for impact on the existing interoperability certification. These discrepancies will be adjudicated to the satisfaction of DISA via a vendor POA&M, which will address all new critical TDRs within 120 days of identification.



LEGEND:

DCO	Defense Connection Online
DISA	Defense Information Systems Agency
DISN	Defense Information Systems Network
DoD	Department of Defense
DoDIN	Department of Defense Information Network
EI	End Instrument
IAP	Internet Access Point
IM	Instant Messaging
IP	Internet Protocol
ISP	Internet Service Provider
LAN	Local Area Network
MCEP	Multi Carrier Entry Point
NETOPS	Network Operations
PKI	Public Key Infrastructure
PSTN	Public Switched Telephone Network
QoS	Quality of Service
SBC	Session Border Controller
SC	Session Controller
SS	Softswitch
STEP	Standardized Tactical Entry Point
UC	Unified Capabilities
VVoIP	Voice and Video over IP
XMPP	Extensible Messaging and Presence Protocol

Figure 2-1. Notional DoDIN Network Architecture



LEGEND:

1G	1 Gigabit Ethernet	IE	Industrial Ethernet
10G	10 Gigabit Ethernet	SUT	System Under Test

Figure 2-2. Interoperability (Heterogeneous) Tested Configuration

6. INTEROPERABILITY REQUIREMENTS, RESULTS, AND ANALYSIS. The interface, Capability Requirements (CR) and Functional Requirements (FR), Cybersecurity, and other requirements for DoDIN ASLAN and non-ASLANs are defined by UCR 2013, Change 1, Sections 4.2, 5.2, and 7.2. Table 3-1 provides the SUT interface interoperability status, and Table 3-2 provides the Capability Requirements (CR) and Functional Requirements (FR) status. Testing details and results are provided in the following sub-paragraphs.

a. The UCR 2013, Change 1, section 7.2.1 includes the General LAN Switch and Router Product Requirements. Core, Distribution, and Access products shall be capable of meeting the following parameters:

(1) The general requirements are listed in the subparagraphs below.

(a) Forwarding Performance Factor (FPF). All Core, Distribution, and Access products shall meet the following FPFs. FPF is based on the capability to send and receive a mixture of 64 to 1518 byte packets at full duplex rates to and from the WAN within the described assured services architecture and with packet loss limits specified in subparagraph (d) below. In a fully forwarding device, all ports can run at full wire speed without any loss of packets. FPF is defined as the ratio of forwarded traffic to the maximum traffic load. Each core, distribution, and access product has up to three levels of performance: minimum, medium, and maximum. The FPF definition includes all hardware and software components. ASLANs and non-ASLAN products must meet the same FPFs. However, the calculation and testing methodology for both differs in that non-ASLAN products need not provide redundant links. Therefore, all egress (WAN-side) trunks can be used to calculate blocking factor. ASLAN products must provide redundancy if they support more than 96-users. Blocking factor calculations must account for redundancy.

1. Access Products. Access products shall have an FPF of 12.5 percent (1/8) or more. Medium performance level access products shall have an FPF of 12.5 percent (1/2) or more. Maximum performance level access products shall have a forwarding factor of 100 percent (all traffic is forwarded). Access devices that support less than 96 telephony users may support 1 interface. The SUT met this requirement with testing and the vendor's LoC. The FPF results for all tested components are listed in Enclosure 3, Table 3-3.

2. Distribution and Core Products. These products shall have an FPF of 50 percent (1/2) or more. Medium performance level products shall have an FPF of 66.6 percent (2/3) or more. Maximum performance level access products shall have a forwarding factor of 100 percent (all traffic is forwarded). Core and distribution products shall minimally support 4 interfaces for assured services connectivity. The SUT was not submitted as a Distribution or Core Product.

(b) Latency. All Core, Distribution, and Access products shall have the capability to transport prioritized packets (media and signaling) as follows. The latency shall be achievable over any 5-minute period measured from ingress ports to egress ports under congested conditions. A congested condition is defined as 100 percent bandwidth utilization. Prioritized packets are defined as packets having a service class above best effort. Voice packets may have no more than 2 milliseconds (ms) latency. Voice and video signaling packets may have no more

than 2 ms latency. Video packets may have no more than 10 milliseconds (ms) latency. The SUT met this requirement with testing. The SUT measured latencies are shown in Table 2-2.

Table 2-2. SUT Measured Latency

Component	Interface	SUT Measured Latency	UCR Requirement for Voice/Video
IE-4000-16GT4G-E	10BaseX	Not Tested (See note 1.)	2 ms / 10 ms
	100BaseX	Not Tested (See note 1.)	2 ms / 10 ms
	1000BaseX	.045 ms voice/.054 ms video latency (See note 2.)	2 ms / 10 ms
	10GBaseX	Not Tested (See note 3.)	2 ms / 10 ms
	40GBaseX	Not Tested (See note 3.)	2 ms / 10 ms
	100GBaseX	Not Tested (See note 3.)	2 ms / 10 ms
IE-4010-16S12P	10BaseX	Not Tested (See note 1.)	2 ms / 10 ms
	100BaseX	Not Tested (See note 1.)	2 ms / 10 ms
	1000BaseX	.044 ms voice/.052 ms video latency (See note 2.)	2 ms / 10 ms
	10GBaseX	Not Tested (See note 3.)	2 ms / 10 ms
	40GBaseX	Not Tested (See note 3.)	2 ms / 10 ms
	100GBaseX	Not Tested (See note 3.)	2 ms / 10 ms
IE-5000-12S12P-10G	10BaseX	Not Tested (See note 1.)	2 ms / 10 ms
	100BaseX	Not Tested (See note 1.)	2 ms / 10 ms
	1000BaseX	.045 ms voice/.059 ms video latency (See note 2.)	2 ms / 10 ms
	10GBaseX	.045 ms voice/.059 ms video latency (See note 2.)	2 ms / 10 ms
	40GBaseX	Not Tested (See note 3.)	2 ms / 10 ms
	100GBaseX	Not Tested (See note 3.)	2 ms / 10 ms

NOTE(S):
1. TSSAP tested the 1000BaseT and 10GBaseX interface but not the 10/100BaseT interfaces. Analysis determined the 10/100BaseT interfaces met these requirements based on the vendor's Letters of Compliance to comply with the IEEE802.3 standards and the testing data collected at all other data rates.
2. The SUT measured latency was captured E2E. Based on analysis of the E2E measurement, TSSAP determined that the SUT met the component latency requirements.
3. The SUT does not support this optional interface.

LEGEND:

10/100BaseT	10/100 Mbps (Baseband Operation, Twisted Pair) Ethernet	100GBaseX	100 Gbps Ethernet over Fiber or Copper
		E2E	End-to-End
10BaseX	10 Mbps Ethernet over Fiber or Copper	IEEE	Institute of Electrical and Electronics Engineers
100BaseX	100 Mbps Ethernet over Fiber or Copper	ms	millisecond
1000BaseX	1000 Mbps Ethernet over Fiber or Copper	SUT	System Under Test
10GBaseX	10 Gbps Ethernet over Fiber or Copper	TSSAP	Telecommunications Systems Security Assessment Program
40GBaseX	40 Gbps Ethernet over Fiber or Copper	UCR	Unified Capabilities Requirements

(c) Jitter. All Core, Distribution, and Access products shall have the capability to transport prioritized packets (media and signaling) as follows. The jitter shall be achievable over any five-minute period measured from ingress ports to egress ports under congested conditions. Congested condition is defined as 100 percent bandwidth utilization. Voice packets may have no more than 1 ms jitter. Video packets may have no more than 10 ms jitter. The SUT met this requirement with testing. The SUT measured jitter for each interface is shown in Table 2-3.

Table 2-3. SUT Measured Jitter

Component	Interface	SUT Measured Jitter	UCR Requirement for Voice/Video
IE-4000-16GT4G-E	10BaseX	Not Tested (See note 1.)	1 ms / 10 ms
	100BaseX	Not Tested (See note 1.)	1 ms / 10 ms
	1000BaseX	.008 ms voice/.012 ms video latency (See note 2.)	1 ms / 10 ms
	10GBaseX	Not Tested (See note 3.)	1 ms / 10 ms
	40GBaseX	Not Tested (See note 3.)	1 ms / 10 ms
	100GBaseX	Not Tested (See note 3.)	1 ms / 10 ms
IE-4010-16S12P	10BaseX	Not Tested (See note 1.)	1 ms / 10 ms
	100BaseX	Not Tested (See note 1.)	1 ms / 10 ms
	1000BaseX	.007 ms voice/.006 ms video latency (See note 2.)	1 ms / 10 ms
	10GBaseX	Not Tested (See note 3.)	1 ms / 10 ms
	40GBaseX	Not Tested (See note 3.)	1 ms / 10 ms
	100GBaseX	Not Tested (See note 3.)	1 ms / 10 ms
IE-5000-12S12P-10G	10BaseX	Not Tested (See note 1.)	1 ms / 10 ms
	100BaseX	Not Tested (See note 1.)	1 ms / 10 ms
	1000BaseX	.010 ms voice/.025 ms video latency (See note 2.)	1 ms / 10 ms
	10GBaseX	.010 ms voice/.025 ms video latency (See note 2.)	1 ms / 10 ms
	40GBaseX	Not Tested (See note 3.)	1 ms / 10 ms
	100GBaseX	Not Tested (See note 3.)	1 ms / 10 ms

NOTE(S):
1. TSSAP tested the 1000BaseT and 10GBaseX interface but not the 10/100BaseT interfaces. Analysis determined the 10/100BaseT interfaces met these requirements based on the vendor's Letters of Compliance to comply with the IEEE802.3 standards and the testing data collected at all other data rates.
2. The SUT measured jitter was captured E2E. Based on analysis of the E2E measurement, TSSAP determined that the SUT met the component jitter requirements.
3. The SUT does not support this optional interface.

LEGEND:

10BaseX	10 Mbps Ethernet over Fiber or Copper	100GBaseX	100 Gbps Ethernet over Fiber or Copper
100BaseX	100 Mbps Ethernet over Fiber or Copper	ms	millisecond
1000BaseX	1000 Mbps Ethernet over Fiber or Copper	SUT	System Under Test
10GBaseX	10 Gbps Ethernet over Fiber or Copper	UCR	Unified Capabilities Requirements
40GBaseX	40 Gbps Ethernet over Fiber or Copper		

(d) Packet Loss. All Core, Distribution and Access products shall have the capability to transport prioritized packets (media and signaling) as follows. The packet loss shall be achievable over any 5-minute period measured from ingress ports to egress ports under congested conditions. Congested condition is defined as 100 percent bandwidth utilization. The SUT met this requirement with testing. The SUT measured packet loss for each interface is shown in Table 2-4.

Table 2-4. SUT Measured Packet Loss

Component	Interface	SUT Measured Packet Loss				UCR Requirement			
		Voice	Video	Preferred Data	Best Effort Data	Voice	Video	Preferred Data	Best Effort Data
IE-4000-16GT4G-E	10BaseX	Not Tested. (See note 1.)				0.015%	0.05%	0.05%	No minimum requirement in the UCR
	100BaseX	Not Tested. (See note 1.)				0.015%	0.05%	0.05%	
	1000BaseX	0.00%	0.00%	0.00%	0.00%	0.015%	0.05%	0.05%	
	10GBaseX	Not Tested. (See note 2.)				0.015%	0.05%	0.05%	
	40GBaseX	Not Tested. (See note 2.)				0.015%	0.05%	0.05%	
	100GBaseX	Not Tested. (See note 2.)				0.015%	0.05%	0.05%	
IE-4010-16S12P	10BaseX	Not Tested. (See note 1.)				0.015%	0.05%	0.05%	No minimum requirement in the UCR
	100BaseX	Not Tested. (See note 1.)				0.015%	0.05%	0.05%	
	1000BaseX	0.00%	0.00%	0.00%	0.00%	0.015%	0.05%	0.05%	
	10GBaseX	Not Tested. (See note 2.)				0.015%	0.05%	0.05%	
	40GBaseX	Not Tested. (See note 2.)				0.015%	0.05%	0.05%	
	100GBaseX	Not Tested. (See note 2.)				0.015%	0.05%	0.05%	
IE-5000-12S12P-10G	10BaseX	Not Tested. (See note 1.)				0.015%	0.05%	0.05%	No minimum requirement in the UCR
	100BaseX	Not Tested. (See note 1.)				0.015%	0.05%	0.05%	
	1000BaseX	0.00%	0.00%	0.00%	0.00%	0.015%	0.05%	0.05%	
	10GBaseX	0.00%	0.00%	0.00%	0.00%	0.015%	0.05%	0.05%	
	40GBaseX	Not Tested. (See note 2.)				0.015%	0.05%	0.05%	
	100GBaseX	Not Tested. (See note 2.)				0.015%	0.05%	0.05%	

NOTE:
1. TSSAP tested the 1000BaseT and 10GBaseX interface but not the 10/100BaseT interfaces. Analysis determined the 10/100BaseT interfaces met these requirements based on the vendor's Letters of Compliance to comply with the IEEE802.3 standards and the testing data collected at all other data rates.
2. The SUT does not support this optional interface.

LEGEND:

10/100BaseT	10/100 Mbps (Baseband Operation, Twisted Pair) Ethernet	40GBaseX	40 Gbps Ethernet over Fiber or Copper0
		100GBaseX	100 Gbps Ethernet over Fiber or Copper
10BaseX	10 Mbps Ethernet over Fiber or Copper	IEEE	Institute of Electrical and Electronics Engineers
100BaseX	100 Mbps Ethernet over Fiber or Copper	SUT	System Under Test
1000BaseX	1000 Mbps Ethernet over Fiber or Copper	TSSAP	Telecommunications Systems Security Assessment Program
10GBaseX	10 Gbps Ethernet over Fiber or Copper	UCR	Unified Capabilities Requirements

(2) Port Interface Rates Requirements

(a) Minimally, Core and Distribution products shall support the following interface rates [other rates and Institute of Electronics and Electrical Engineers (IEEE) standards maybe provided as optional interfaces]. Rates specified are the theoretical maximum data bit rate specified for Ethernet; link capacity and effective throughput is influenced by many factors. For calculation purposes, link capacities are to be calculated IAW definitions contained in Request for Comments (RFC) 2330 and RFC 5136. Network Management (NM) interfaces are defined in Section 2.19. Core products that support assured services shall have a minimum of 4 fiber interfaces for connecting to WAN and Distribution products. Distribution products that support assured services shall have a minimum of 4 fiber interfaces for interconnecting to the core, peer distribution, and access products.

The product must minimally support one or more of the following fiber interfaces. The SUT was submitted as an Access only device.

- 1 Gbps IAW IEEE 802.3z (for interconnection between the core to WAN, distribution-core, and distribution-access).
- 10 Gbps IAW IEEE 802.3ae.
- 40 Gbps IAW IEEE 802.3ba (single mode fiber).
- 100 Gbps IAW IEEE 802.3ba (single mode fiber).

(b) Minimally, Access products shall provide one of the following user-side interface rates (other rates and IEEE standards may be provided as optional interfaces). The SUT met this requirement with testing and the vendor's LoC. The SUT met the Access user side requirement with the 10/100/1000 IEEE 802.3i/u/ab interfaces.

- 10 Mbps IAW IEEE 802.3i.
- 10 Mbps IAW IEEE 802.3j.
- 100 Mbps IAW IEEE 802.3u.
- 1000 Mbps IAW IEEE 802.3z.
- 1000 Mbps IAW IEEE 802.3ab.
- 10 Gbps IAW IEEE 802.3ae.

(c) Minimally, Access products shall provide one of the following trunk-side interface rates (other rates and IEEE standards may be provided as optional interfaces). The SUT met this requirement with testing and the vendor's LoC. The SUT met the Access trunk-side requirement with the 1/10 IEEE 802.3z/ae interfaces.

- 1 Gbps IAW IEEE 802.3z.
- 10 Gbps IAW IEEE 802.3ae.
- 40 Gbps IAW IEEE 802.3ba (single mode fiber).
- 100 Gbps IAW IEEE 802.3ba (single mode fiber).

(d) Access products that support assured services and more than 96 telephony subscribers shall have a minimum of 2 fiber interfaces to connect to the distribution layer. The SUT supports less than 96 users.

(e) The Core, Distribution, and Access products may provide a fibre channel interface IAW American National Standards Institute (ANSI) International Committee for Information Technology Standards (INCITS) T11.2 and T11.3 (previously known as X3T9.3). If provided, the interface must meet the following RFCs: The SUT was note tested for this conditional requirement because the SUT does not support a fibre channel interface.

- RFC 4338, Transmission of IPv6, IPv4, and Address Resolution Protocol (ARP) Packets over Fibre Channel.
- RFC 4044, Fibre Channel Management.

(f) The Core, Distribution, and Access products may provide one or more of the following wireless LAN interface rates. Wireless interfaces were not submitted for certification for this SUT:

- 54 Mbps IAW IEEE 802.11a.
- 11 Mbps IAW IEEE 802.11b.
- 54 Mbps IAW IEEE 802.11g.
- 300–600 Mbps IAW IEEE 802.11n.
- 500 – 1000 Mbps IAW IEEE 802.11ac.
- IEEE 802.16-2012: Broadband wireless communications standards for MANs.
- Other approved IEEE wireless interfaces may be implemented as optional interfaces.

(g) If any of the above wireless interfaces are provided, then the interfaces must support the requirements of Section 7.3, Wireless LAN. The SUT does not support the optional wireless interfaces.

(3) Port Parameter Requirements. The Core, Distribution, and Access products shall provide the parameters on a per port basis as specified in the following subparagraphs. These are required for core, distribution, and Layer 2 (L2)/Layer 3 (L3) access unless specified otherwise.

(a) Auto-negotiation IAW IEEE 802.3. All interfaces shall support auto-negotiation even when the IEEE802.3 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 this requirement with testing and the vendor's LoC.

(b) Force mode IAW IEEE 802.3. The SUT met this requirement with testing.

(c) Flow control IAW IEEE 802.3x (Optional: Core). The SUT met this requirement with the vendor's LoC.

(d) Filtering IAW appropriate RFC 1812 sections (sections applying to filtering). The SUT met this requirement with the vendor's LoC.

(e) Link Aggregation IAW IEEE 802.1AX (applies to output/egress trunk-side ports only) (Optional Access). This optional requirement was not tested; the SUT supports less than 96 users.

(f) Spanning Tree Protocol IAW IEEE 802.1D (Optional: Core). The SUT met this requirement with testing and the vendor's LoC.

(g) Multiple Spanning Tree IAW IEEE 802.1s (Optional: Core). The SUT met this requirement with testing and the vendor's LoC.

(h) Rapid Reconfiguration of Spanning Tree IAW IEEE 802.1w (Optional: Core). The SUT met this requirement with the vendor's LoC.

(i) Port-Based Access Control IAW IEEE 802.1x (Optional: Core, Distribution, and Access). The SUT met this requirement with the vendor's LoC.

(j) Link Layer Discovery Protocol (LLDP) IAW IEEE 802.1AB (Optional Core, Distribution, and Access). The SUT met this requirement with the vendor's LoC.

(k) Link Layer Discovery – Media Endpoint Discovery IAW ANSI/ Telecommunications Industry Association (TIA)-1057 (Optional Core, Distribution, and Access). The SUT met this requirement with the vendor's LoC.

(l) Power over Ethernet (PoE) IAW either 802.3af-2003 or 802.3at-2009. (Required only for VVoIP solutions; for data applications or non-Assured Services (AS) solutions, PoE is optionally required). This requirement was met through vendor's LoC for the IE-4010-16S12P and IE-5000-12S12P-10G. The IE-4000-16GT4G-E does not support this requirement.

(m) Shortest Path Bridging (SPB) [Optional]. If supported, the product shall provide shortest path bridging (SPB) IAW RFC 6329 and IEEE 802.1aq. (Note: Requires IS-IS as routing protocol.) The SUT does not support this optional requirement.

(n) Transparent Interconnection of Lots of Links (TRILL) [Optional]. If supported, the product shall provide TRILL IAW RFCs 6325, 6326, 6327, 6349, and 6350. Devices may support conditional interfaces (FCoE and PPP). If the conditional interfaces are provided RFCs 6847 (FCoE) and 6361 (PPP) shall be applicable. (Note: Requires IS-IS as routing protocol.) The SUT does not support this optional requirement.

(4) Class of Service Markings Requirements

(a) The Core, Distribution, and Access products shall support Differentiated Services Code Points (DSCPs) IAW RFC 2474 for both Internet Protocol (IP) IPv4 and IPv6 Packets, as follows:

1. Core and Distribution Products. The Core and Distribution products shall be capable of accepting any packet tagged with a DSCP value (0-63) on an ingress port and assign that packet to a Quality of Service (QoS) behavior listed in Section 7.2.1.6, Quality of Service Features. The SUT was not submitted as a Distribution or Core product.

2. Core and Distribution Products. The Core and Distribution products shall be capable of accepting any packet tagged with a DSCP value (0-63) on an ingress port and reassign that packet to any new DSCP value (0-63). Current DSCP values are provided in Section 6.3.2, Traffic Conditioning Specification. (Optional: Access products). The SUT was not submitted as a Distribution or Core product.

3. Core and Distribution Products. The Core and Distribution products must be able to support the prioritization of aggregate service classes with queuing according to Section 7.2.1.6, Quality of Service Features. The SUT was not submitted as a Distribution or Core product.

4. Access products. Access products shall be capable of supporting the prioritization of aggregate service classes with queuing according to Section 7.2.1.6, Quality of Service Features. Queuing may be supported in either of the two following class of service (CoS) methods:

a. Layer 3 CoS. Layer 3 Cos involves support for DSCP IAW RFC 2474 for IPv4 and IPv6. Within this CoS method, the access product shall support queuing by either: a) queuing directly based on the DSCP within the IP header (IPv4 and IPv6). The original DSCP value must also be preserved and passed unaltered through the product; or, b) The product shall inspect the IP header (IPv4 and IPv6). Based on the DSCP value contained within the IP header, the product may map the DSCP value (0-63) to the Ethernet priority field (decimal values 0-7). Queuing may be based on the mapping of the DSCP to a layer 2 priority field value. Any received DSCP value (0-63) must be able to be mapped to any priority value (0-7). The original DSCP value must be preserved and passed unaltered through the product. This requirement was met with testing and the vendor's LoC.

b. Layer 2 CoS. Layer 2 CoS shall use the Virtual LAN identification (VLAN ID), see Section 7.2.1.4, defined in IEEE 802.1Q to perform queuing assignment. Access devices shall be capable of assigning any VLAN ID (either directly or through the 3 Ethernet priority bits (decimal values 0 through 7) to any of the 4 queues. This requirement was met with testing and the vendor's LoC.

(b) The Core, Distribution, and Access products may support the 3-bit user priority field of the IEEE 802.1Q 2-byte Tag Control Information (TCI) field (see Figure 7.2-1, IEEE 802.1Q Tagged Frame for Ethernet, and Figure 7.2-2, TCI Field Description). Default values are provided in Table 7.2-1, 802.1Q Default Values. If provided, the following Class of Service (CoS) requirements apply:

1. Core, Distribution, and Access Products. The Core, Distribution, and Access products shall be capable of accepting any frame tagged with a user priority value (0–7) on an

ingress port and assign that frame to a QoS behavior listed in Section 7.2.1.6, Quality of Service Features. The SUT was not submitted as a Distribution or Core product.

2. Core and Distribution Products. The Core and Distribution products shall be capable of accepting any frame tagged with a user priority value (0-7) on an ingress port and reassign that frame to any new user priority value (0-7) (Optional: Distribution and Access). The SUT was not submitted as a Distribution or Core product.

(5) Virtual LAN Capabilities Requirements

(a) The Core, Distribution, and Access products shall be capable of the following:

1. Accepting Virtual Local Area Network (VLAN) tagged frames according to IEEE 802.1Q (see Figure 7.2-1, IEEE 802.1Q Tagged Frame for Ethernet, and Figure 7.2-2, TCI Field Description). The SUT met this requirement with testing and the vendor's LoC.

2. Configuring VLAN IDs (VIDs). VIDs on an ingress port shall be configurable to any of the 4094 values (except 0 and 4095). The SUT met this requirement with testing and the vendor's LoC.

3. Supporting VLANs types IAW IEEE 802.1Q. The SUT met this requirement with testing and the vendor's LoC.

(b) The DoDIN products must be capable of accepting VLAN tagged frames and assigning them to the VLAN identified in the 802.1Q VID field (see Figure 7.2-4, IEEE 802.1Q-Based VLANs). The SUT met this requirement with testing and the vendor's LoC.

(6) Protocol Requirements. The Core, Distribution, and Access products shall meet protocol requirements for IPv4 and IPv6. The RFC requirements are listed in UCR 2013, Change 1, Table 7.2-2, ASLAN Infrastructure RFC Requirements. Additional IPv6 requirements by product profile are listed in UCR 2013, Change 1, Section 5, IPv6. These RFCs are not meant to conflict with Department of Defense (DoD) Cybersecurity policy [e.g., Security Technical Implementation Guidelines (STIGs)]. Whenever a conflict occurs, DoD Cybersecurity policy takes precedence. If a conflict occurs with Section 5, RFCs applicable to IPv6 in Section 5 take precedence. The SUT met this requirement with the vendor's LoC.

(7) Quality of Service Features Requirements

(a) The Core, Distribution, and Access products shall be capable of the following QoS Features:

1. Providing a minimum of four queues. The SUT met this requirement with testing.

2. Assigning any incoming access/user-side "tagged" session to any of the queues for prioritization onto the egress (trunk-side/network-side) interface. The SUT met this requirement with testing and the vendor's LoC.

3. Supporting Differentiated Services (DS), Per-Hop Behaviors (PHBs), and traffic conditioning IAW RFCs 2474, 2597, and 3246. The SUT met this requirement with testing and the vendor's LoC.

4. All queues shall be capable of having a bandwidth (BW) assigned (i.e., queue 1: 200 Kbps, queue 2: 500 kbps) or percentage of traffic (queue 1: 25 percent, queue 2: 25 percent). The BW or traffic percentage shall be fully configurable per queue from 0 to full BW or 0 to 100 percent. The sum of configured queues shall not exceed full BW or 100 percent of traffic. The SUT met this requirement with testing and the vendor's LoC.

5. Core, Distribution, and Access products shall meet the traffic conditioning (policing) requirements of Section 6.2.4 as follows. The product shall calculate the bandwidth associated with traffic conditioning, which requires that the queue size should account for the Layer 3 header (i.e., IP header), but not the Layer 2 headers (i.e., Point-to-Point Protocol [PPP], MAC, and so on) within a margin of error of plus or minus10 percent. When the other queues are not saturated, the Best Effort traffic may surge beyond its traffic-engineered limit. The SUT met this requirement with testing and the vendor's LoC.

6. Optionally provide a minimum of six queues (see Six-Queue Design). The SUT was not tested for this optional requirement.

(b) The product shall support the Differentiated Services Code Point (DSCP) plan, as shown in Table 7.2-3, DSCP Assignments. DS assignments shall be software configurable for the full range of six bit values (0-63 Base10) for backwards compatibility with IP precedence environments that may be configured to use the Type of Service (TOS) field in the IP header but do not support DSCP. The SUT met this requirement with the vendor's LoC.

(8) Network Monitoring Requirements. The Core, Distribution, and Access products shall support the following network monitoring features:

1. Simple Network Management Protocol Version 3 (SNMPv3) IAW RFCs 3411, 3412, 3413, 3414, 3415, 3416, and 3417. The SUT met this requirement with testing and the vendor's LoC.

2. Remote Monitoring (RMON) IAW RFC 2819. The product shall minimally support the following RFC 2819 groups: Ethernet statistics, history control, Ethernet history, and alarm. The SUT met this requirement with the vendor's LoC.

3. Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework IAW RFC 3584. The SUT met this requirement with the vendor's LoC.

4. The Advanced encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model IAW RFC 3826. The TSSAP-led Cybersecurity test team tested Security and published the results in a separate report, Reference (d).

(9) Security Requirements. The Core, Distribution, and Access products shall meet the security protocol requirements listed in Section 4, Cybersecurity, as follows: Core and Distribution products shall meet all requirements annotated as Router (R) and LAN Switch (LS). Access switches shall meet the cybersecurity requirements annotated for LS. In addition to wireless cybersecurity requirements previously specified, Wireless Local Area Network Access Systems (WLASs) and Wireless Access Bridges (WABs) shall meet all cybersecurity requirements for LSs. Wireless End Instruments (WEIs) shall meet all cybersecurity requirements annotated for End Instruments (EIs). When conflicts exist between the Unified Capabilities Requirements (UCR) and STIG requirements, the STIG requirements will take precedence. The SUT met the requirements in the UCR 2013, Change 1, Section 4, with the vendor's LoC. In addition, the TSSAP-led Cybersecurity test team tested Security and published the results in a separate report, Reference (d).

b. The UCR 2013, Change 1, section 7.2.2 includes the LAN Switch and Router Redundancy Requirements. The ASLAN (High and Medium) shall have no single point of failure that can cause an outage of more than 96 IP telephony subscribers. A single point of failure up to and including 96 subscribers is acceptable; however, to support mission-critical needs, FLASH/FLASH OVERRIDE (F/FO) subscribers should be engineered for maximum availability. To meet the availability requirements, all switching/routing platforms that offer service to more than 96 telephony subscribers shall provide redundancy in either of two ways:

- The product itself (Core, Distribution, or Access) provides redundancy internally.
- A secondary product is added to the ASLAN to provide redundancy to the primary product (redundant connectivity required).

(1) Single Product Redundancy Requirements. If a single product is used to meet the redundancy requirements, then the following requirements are applicable to the product.

- Dual Power Supplies
- Dual Processors (Control Supervisors)
- Termination Sparing
- Redundancy Protocol
- No Single Failure Point
- Switch Fabric or Backplane Redundancy
- In the event of a component failure in the product, all calls that are active shall not be disrupted (loss of existing connection requiring redialing) and all traffic flows shall be restored within 5 seconds.

This requirement was not tested, the SUT supports less than 96 users.

(2) Dual Product Redundancy Requirements. If the SUT provides redundancy through dual products, then the requirements in the following subparagraphs are applicable.

(a) The failover over to the secondary product must not result in any lost calls (loss of existing connection requiring redialing).

(b) Failover to the secondary product shall complete within 5 seconds with all traffic flows restored.

The SUT was submitted as a Layer 2 Access only switch.

(3) Survivability. An ASLAN product is required to use routing protocols IAW the DoD Information Technology (IT) Standards Registry (DISR) to provide survivability. The minimum routing protocols that must be supported are as follows:

- The product shall support Border Gateway Protocol (BGP) for inter-domain routing.
- The product shall support Open Shortest Path First (OSPF), Version 2, for IPv4 and OSPF Version 3 for IPv6, July 2008, and IAW RFC 5340.
- If OSPF is Supported, the product shall support OSPFv2 Graceful restart (RFC 3623) and OSPFv3 Graceful Restart (RFC 5187).
- If the Intermediate System to Intermediate System (IS-IS) protocol is supported, IS-IS shall be compliant with RFC 1195 – "Use of OSI IS-IS for Routing in TCP/IP and Dual Environments", 1990; RFC 2763 – "Dynamic Host Name Exchange Mechanism for IS-IS", 2000; RFC 2966 – "Domain-wide Prefix Distribution with Two-Level IS-IS", 2000; and RFC 3373 – "Three-Way Handshake for Intermediate System to Intermediate System (IS-IS) Point-to-Point Adjacencies", 2002. For IPv6, IS-IS shall meet RFC 5340, Routing Ipv6 with IS-IS.
- If OSPF is Supported, the product shall support OSPFv2 Graceful restart (RFC 3623) and OSPFv3 Graceful Restart (RFC 5187).
- Graceful Restart for BGP (RFC 4724) is required for core and distribution infrastructure products.
- The product shall support Virtual Router Redundancy Protocol (VRRP) – RFCs 2787 and RFC 5798 - to provide redundancy to Layer 2 switches that lose connectivity to a Layer 3 router. The Distribution product shall employ VRRP to provide survivability to any product running Layer 2 (normally the Access Layer).

The SUT was submitted as a Layer 2 Access switch only.

c. The UCR 2013, Change 1, section 7.2.3 includes the LAN Product Requirements Summary. Table 7.2-4 summarizes the LAN product requirements. These requirements were verified via a combination of Letter(s) of Compliance (LoCs) are addressed in other sections of this document. The SUT met these requirements with testing and the vendor's LoC.

d. The UCR 2013, Change 1, section 7.2.4 includes the Multiprotocol Label Switching Requirements in ASLANs. The implementation of ASLANs sometimes may cover a large geographical area. For large ASLANs, a data transport technique referred to as Multiprotocol Label Switching (MPLS) may be used to improve the performance of the ASLAN core layer.

(1) MPLS ASLAN. An ASLAN product that implements MPLS must still meet all the ASLAN requirements for jitter, latency, and packet loss. The addition of the MPLS protocol must not add to the overall measured performance characteristics with the following caveats: The MPLS device shall reroute data traffic to a secondary pre-signaled Label Switched Path (LSP) in less than 5 seconds upon indication of the primary LSP failure. The ASLAN Core and

Distribution products that will be used to provide MPLS services must support the RFCs contained in Table 7.2-5, ASLAN Product MPLS Requirements. The SUT does not support this optional requirement.

(2) MPLS VPN Augmentation to VLANs. If an ASLAN product supports MPLS, it shall support MPLS layer 2 VPNS IAW RFC 4762. The product may additionally support RFC 4761 and RFC 5501. ASLAN products that support MPLS shall also support MPLS layer 3 VPNs IAW RFC 4364, RFC 4382, RFC 4577, RFC 4659, and RFC 4684. The MPLS device must support QoS in order to provide for assured services. The product must support one of the following QoS mechanisms: DSCP mapping to 3 bit EXP field (E-LSP) or Label description of PHB (L-LSP). The SUT does not support this optional requirement.

7. Hardware/Software/Firmware Version Identification: Table 3-3 provides the SUT components' hardware, software, and firmware tested. TSSAP, JBSA-Lackland, Texas, tested the SUT in an operationally realistic environment to determine its interoperability capability with associated network devices and network traffic. Table 3-4 provides the hardware, software, and firmware of the components used in the test infrastructure.

8. TESTING LIMITATIONS. None.

9. CONCLUSION(S). The SUT meets the critical interoperability requirements for an ASLAN Layer 2 Access Switch in accordance with the UCR and is certified for joint use with other DoDIN Products listed on the Approved Products List (APL). The SUT meets the interoperability requirements for the interfaces listed in Enclosure 3, Table 3-1. The SUT was submitted for and tested in an ASLAN heterogeneous environment.

DATA TABLES

Table 3-1. Interface Status

Interface (See note 1.)	Applicability ASLAN			Status (Met, Partially Met, Not Met, Not Tested)	Remarks
	Co	D	A		
Network Management Interfaces					
IEEE 802.3i (10BaseT UTP)	C	C	C	Met	
IEEE 802.3u (100BaseT UTP)	C	C	C	Met	
IEEE 802.3ab (1000BaseT UTP)	C	C	C	Met	
Access (User) Interfaces (See note 2.)					
IEEE 802.3i (10BaseT UTP)	C	C	C	Met	
IEEE 802.3u (100BaseT UTP)	C	C	C	Met	
IEEE 802.3u (100BaseFX)	C	C	C	Not Tested	(See note 3.)
IEEE 802.3ab (1000BaseT UTP)	C	C	C	Met	
IEEE 802.3z (1000BaseX Fiber)	C	C	C	Met	
IEEE 802.3ae (10GBaseX)	C	C	C	Not Tested	(See note 3.)
IEEE 802.3ba (40GBaseX)	O	O	O	Not Tested	(See note 3.)
IEEE 802.3ba (100GBaseX)	O	O	O	Not Tested	(See note 3.)
Uplink (Trunk) Interfaces (See note 2.)					
IEEE 802.3u (100BaseT UTP)	O	O	O	Met	
IEEE 802.3u (100BaseFX)	O	O	O	Not Tested	(See note 3.)
IEEE 802.3ab (1000BaseT UTP)	O	O	O	Met	
IEEE 802.3z (1000BaseX Fiber)	C	C	C	Met	
IEEE 802.3ae (10GBaseX)	C	C	C	Met	(See note 4.)
IEEE 802.3ba (40GBaseX)	C	C	C	Not Tested	(See note 3.)
IEEE 802.3ba (100GBaseX)	C	C	C	Not Tested	(See note 3.)

NOTE(S):

1. The SUT high-level requirements are depicted in Table 3. These high-level requirements refer to a more detailed list of requirements provided in Enclosure 3, Table 3-2.
2. Core, Distribution, and Access products must minimally support one of the interfaces listed in this table as conditional for the given role. Other rates and standards may be provided as optional interfaces.
3. The SUT does not support this (conditional or optional) interface.
4. The only component of the SUT supporting this interface is the IE-5000-12S12P-10G.

LEGEND:

802.3ab	1000BaseT Gbps Ethernet over Twisted Pair	100GBaseX	100000 Mbps Ethernet over Fiber or Copper
802.3ae	10 Gbps Ethernet over Fiber	A	Access
802.3ba	40 and 100 Gigabit Ethernet over Twisted pair and Fiber	ASLAN	Assured Services Local Area Network
802.3i	10BaseT 10 Mbps Ethernet over Twisted Pair	C	Conditional
802.3u	Fast Ethernet at 100 Mbps, copper and Fiber	Co	Core
802.3z	Gigabit Ethernet over Fiber	D	Distribution
10BaseT	10 Mbps (Baseband Operation, Twisted Pair) Ethernet	Gbps	Gigabits per second
100BaseFX	100 Mbps Ethernet over Fiber	IEEE	Institute of Electrical and Electronics Engineers
100BaseT	100 Mbps (Baseband Operation, Twisted Pair) Ethernet	Mbps	Megabits per second
1000BaseT	1000 Mbps (Baseband Operation, Twisted Pair) Ethernet	O	Optional
1000BaseX	1000 Mbps Ethernet over Fiber or Copper	SUT	System Under Test
10GBaseX	10000 Mbps Ethernet over Fiber or Copper	UTP	Unshielded Twisted Pair
40GBaseX	40000 Mbps Ethernet over Fiber or Copper		

Table 3-2. Capability and Functional Requirements and Status

CR/FR ID	Capability/Function	Applicability (See note 1.)	UCR 2013 Change 1 Reference	Status (Met/Partially Met/ Not Met/Not tested)
1	**General LAN Switch and Router Product**			
	Port Interface Rates	Required	7.2.1.1	Met
	Port Parameter	Required	7.2.1.2	Met
	Class of Service Markings	Required	7.2.1.3	Met
	Virtual LAN Capabilities	Required	7.2.1.4	Met
	Protocol Requirements	Required	7.2.1.5	Met
	Quality of Service Features	Required	7.2.1.6	Met
	Network Monitoring	Required	7.2.1.7	Met
	Security	Required	7.2.1.8	Met (See note 2.)
2	**LAN Switch and Router Redundancy**			
	Single Product Redundancy	Optional	7.2.2.1	Not Tested (See note 3.)
	Dual Product Redundancy	Optional	7.2.2.2	Not Tested (See note 3.)
3	**LAN Product Requirements Summary**			
	LAN Product Requirements Summary	Optional	7.2.3	Met
4	**Multiprotocol Label Switching**			
	MPLS ASLAN	Optional	7.2.4.2	Not Tested (See note 3.)
	MPLS VPN Augmentation to VLANs	Optional	7.2.4.3	Not Tested (See note 3.)

NOTE(S):
1. The annotation of 'required' refers to a high-level requirement category. The applicability of each sub-requirement is provided in the UCR 2013, Change 1, Reference (b). The system under test does not need to provide conditional requirements. However, if a capability is provided, it must function according to the specified requirements.
2. Security is tested by a TSSAP-led Cybersecurity test team and the results are published in a separate report, Reference (d).
3. The SUT does not support this optional requirement.

LEGEND:

ASLAN	Assured Services Local Area Network	MPLS	Multiprotocol Label Switching
CR	Capability Requirement	SUT	System Under Test
DISA	Defense Information Systems Agency	TSSAP	Telecommunications Systems Security Assessment Program
FR	Functional Requirements		
ID	Identification	UCR	Unified Capabilities Requirements
LAN	Local Area Network	VLAN	Virtual Local Area Network
		VPN	Virtual Private Network

Table 3-3. SUT Hardware/Software/Firmware Version Identification with Interface Card Forwarding Performance Factors

Component (See note 1.)	Release	Sub-component	Description (See note 3.)	FPF Level (See note 2.)		
				C	D	A
IE-4000-16GT4G-E	15.2E	None	**IE 4000 Switch 4 (GE) combo ports, 16 (GE) copper ports**	Not Certified	Not Certified	Minimum
IE-4000-4TC4G-E			IE 4000 Switch 4 (GE) combo ports, 4 (FE) combo ports	Not Certified	Not Certified	Maximum (See note 6.)
IE-4000-8T4G-E			IE 4000 Switch 4 (GE) combo ports, 8 (FE) copper ports	Not Certified	Not Certified	Maximum (See note 6.)
IE-4000-8S4G-E			IE 4000 Switch 4 (GE) combo ports, 8 (FE) fiber ports	Not Certified	Not Certified	Maximum (See note 6.)
IE-4000-4T4P4G-E			IE 4000 Switch 4 (GE) combo ports, 8 (FE) copper ports	Not Certified	Not Certified	Maximum (See note 6.)
IE-4000-16T4G-E			IE 4000 Switch 4 (GE) combo ports, 16 (FE) copper ports	Not Certified	Not Certified	Maximum (See note 6.)

Table 3-3. SUT Hardware/Software/Firmware Version Identification with Interface Card Forwarding Performance Factors (continued)

Component (See note 1.)	Release	Sub-component	Description (See note 3.)	FPF Level (See note 2.)		
				C	D	A
IE-4000-4S8P4G-E	15.2E	None	IE 4000 Switch 4 (GE) combo, 4 (FE) SFP, 8 (FE) copper ports	Not Certified	Not Certified	Maximum (See note 6.)
IE-4000-8GT4G-E			IE 4000 Switch 4 (GE) combo ports, 8 (GE) copper ports	Not Certified	Not Certified	Medium (See note 5.)
IE-4000-8GS4G-E			IE 4000 Switch 4 (GE) combo ports, 8 (GE) fiber ports	Not Certified	Not Certified	Maximum (See note 6.)
IE-4000-4GC4GP4G-E			IE 4000 Switch 8 (GE) combo ports, 4 (GE) copper ports	Not Certified	Not Certified	Maximum (See note 6.)
IE-4000-8GT8GP4G-E			IE 4000 Switch 4 (GE) combo ports, 16 (GE) copper ports	Not Certified	Not Certified	Minimum (See note 4.)
IE-4000-4GS8GP4G-E			IE 4000 Switch 4 (GE) combo, 4 (GE) fiber, 8 (GE) copper ports	Not Certified	Not Certified	Maximum (See note 6.)
IE-4010-16S12P			**IE 4010 Switch 16 (GE) SFP, 12 (GE) copper ports**	Not Certified	Not Certified	Maximum
IE-4010-4S24P			IE 4010 Switch 4 (GE) SFP, 12 (GE) copper ports	Not Certified	Not Certified	Minimum (See note 4.)
IE-5000-12S12P-10G			**IE 5000 Switch 4 (GE) SFP+, 24 (GE) copper ports**	Not Certified	Not Certified	Maximum
IE-5000-16S12P			IE 5000 Switch 4 SFP, 12 (FE/GE) fiber ports, 12 (GE) copper ports	Not Certified	Not Certified	Maximum (See note 4.)

NOTE(S):

1. There are three levels of FPFs for core, distribution, and access switches. For Core and Distribution, the minimum level is 2 to 1, medium level is 1.5 to 1, and maximum level is 1 to 1 (100 percent FPF). For Access, the minimum level is 8 to 1, medium level is 2 to 1, and maximum level is 1 to 1 (100 percent FPF) or less than 1 to 1.
2. The Cisco IE Switches were loaded with full line rate Layer 2 traffic in order to stress the port ASICs. The IE switches were tested as described in Test-Procedure IO-17c of the ASLAN Test Procedures, Reference (d), for standalone configurations. Based on the DoD architecture as defined in Reference (b), Figure 7.1-2, the FPF for an Access switch is based upon the ratio of the total bandwidth of all SUT Access ports at maximum line rate to the bandwidth of all uplink ports (at max data rate) in a Link Aggregation Group (LAG).
3. The reference to "combo" means the port can be configured for a copper or a fiber interface. If the port is being used as an Uplink, then the port must be configured with a fiber interface to meet the requirements in the UCR 2013 Change 1.
4. This SUT component has a ratio of aggregate Access port bandwidth (at max line rate) to aggregate uplink bandwidth (at max line rate) that exceeds 2 to 1 and is less than 8 to 1, so its FPF is rated minimum.
5. This SUT component has a ratio of aggregate Access port bandwidth (at max line rate) to aggregate uplink bandwidth (at max line rate) that is greater than 1 to 1, but less than or equal to 2 to 1, so its FPF is rated medium.
6. This SUT component has a ratio of aggregate Access port bandwidth (at max line rate) to aggregate uplink bandwidth (at max line rate) that is 1 to 1 or less than 1, so its FPF is rated maximum.

LEGEND:

A	Access	GE	Gigabit Ethernet
ASIC	Application-Specific Integrated Circuit	IE	Industrial Ethernet
ASLAN	Assured Services Local Area Network	IO	Interoperability
C	Core	PoE	Power over Ethernet
D	Distribution	SFP/+	Small Form-factor Pluggable / Plus
DoD	Department of Defense	SUT	System Under Test
FE	Fast Ethernet	TSSAP	Telecommunications Systems Security Assessment Program
FPF	Forwarding Performance Fact		

Table 3-4. Test Infrastructure Hardware/Software/Firmware Version Identification

System Name	Software Release	Function
Required Ancillary Equipment (Site-Provided)		
Windows Server	2012 Enterprise Release 2	Active Directory, Certificate Authority
Windows Server	2012 Enterprise Release 2 with Solarwinds Kiwi v9.3	SysLog Server
Linux Server	Fedora Core 5, Redhat Linux Release 6	NTP Server
TACACS Server	Cisco ACS version 5.5	AAA Server
Test Network Components		
Cisco 4500-X	3.6.0E	Core Switch
Brocade MLXe	5.6.0a	Distribution Switch
Ixia IxNetwork	7.30.917.27 GA	TMDE

LEGEND:

AAA	Authentication, Authorization, and Accounting	TACACS	Terminal Access Controller Access-Control System
ACS	Authentication Control Server	TMDE	Test, Measurement & Diagnostic Equipment
NTP	Network Time Protocol	v	Version
SysLog	System Log		